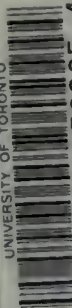


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THE
NATURAL HISTORY OF ANIMALS
[CLASS MAMMALIA].





BRITISH WILD CATTLE. (*Bos primigenius*)

CHILLINGHAM PARK

Frontis Vol II

THE
NATURAL HISTORY
OF
ANIMALS

(CLASS MAMMALIA—ANIMALS WHICH SUCKLE THEIR YOUNG),

IN WORD AND PICTURE.

BY CARL VOGT, — AND — FRIEDRICH SPECHT,

PROFESSOR OF NATURAL HISTORY IN THE UNIVERSITY OF GENEVA,

OF STUTTGART, THE DISTINGUISHED DELINEATOR OF ANIMAL LIFE.

TRANSLATED AND EDITED WITH ADDITIONS

BY

GEORGE G. CHISHOLM, M.A., B.SC., F.R.G.S.

AUTHOR OF "THE WORLD AS IT IS;"

TRANSLATOR OF "SWITZERLAND: ITS SCENERY AND ITS PEOPLE;" ETC.

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THE CONTENTS.

WHALES AND DOLPHINS (CETACEA).	
	PAGE
Introduction,	1
THE TOOTHED WHALES (Denticete),	4
<i>The Dolphins (Delphinida)</i> ,	4
Fresh-water Dolphin (<i>Platanista gangetica</i>),	4
Inia or Amazon Dolphin (<i>Inia amazonica</i>),	4
Common Dolphin (<i>Delphinus delphis</i>),	5
Bottle-nosed Dolphin (<i>Delphinus tursio</i>),	6
Porpoise (<i>Phocæna communis</i>),	7
Killer-whale (<i>Orca gladiator</i>),	8
Pilot or Caaing Whale (<i>Globicephalus melas</i>),	8
Beluga or White Whale (<i>Beluga leucas</i>),	10
Narwhal (<i>Monodon monoceros</i>),	10
<i>The Sperm-whale Family (Physeterida)</i> ,	12
Bottlehead or Common Beaked whale (<i>Hyperoodon rostratus</i>),	12
Sperm-whale or Cachalot (<i>Physeter macrocephalus</i>),	13
THE WHALEBONE WHALES (Mysticete),	14
<i>Fin-backed Whales (Balænoptera)</i> ,	16
Rorqual (<i>Balænoptera boops</i>),	16
<i>The Right Whales (Balænida)</i> ,	16
Greenland or Right Whale (<i>Balæna mysticetus</i>),	16
Cape Whale (<i>Balæna australis</i>),	16
Geographical Distribution and Descent of the Whales and Dolphins,	17
THE SEA-COWS (SIRENIA).	
Introduction,	20
Rhytina of the Behring Sea,	21
Dugong (<i>Halicore Dugong</i>),	21
Manatee of West Africa (<i>Manatus senegalensis</i>),	22
Manatee of the Amazon (<i>Manatus australis</i>),	22
Geographical Distribution and Descent of the Sea-cows,	24
THE ELEPHANTS (PROBOSCIDEA).	
Introduction,	26
African Elephant (<i>Elephas africanus</i>),	30
Indian Elephant (<i>Elephas indicus</i>),	31
Mammoth (<i>Elephas primigenius</i>),	31
Geographical Distribution and Descent of the Proboscideans,	35

VOL. II.

ODD-TOED UNGULATES (PERISSODACTYLA).	
	PAGE
Introduction,	38
THE ROCK-BADGER OR CONY FAMILY (Hyracida),	39
Cape Daman (<i>Hyrax capensis</i>),	41
Syrian Hyrax (<i>Hyrax syriacus</i>),	41
Abyssinian Hyrax or Ashkok (<i>Hyrax habessinicus</i>),	41
THE TAPIR FAMILY (Tapirida),	41
Brazilian Tapir or Anta (<i>Tapirus americanus</i>),	43
Malayan or Shabrack Tapir (<i>Tapirus indicus</i>),	44
Andes or Hairy Tapir (<i>Tapirus Roulinii</i> or <i>villosus</i>),	44
Baird's Tapir (<i>Elasmognathus Bairdii</i>),	44
THE RHINOCEROS FAMILY (Nasicornia),	44
Quaternary Rhinoceros (<i>Rhinoceros tichorhinus</i>),	45
Indian Rhinoceros (<i>Rhinoceros indicus</i>),	47
Javan Rhinoceros (<i>Rhinoceros javanicus</i>),	47
Sumatran Rhinoceros (<i>Rhinoceros sumatrensis</i>),	47
Malaccan Rhinoceros (<i>Rhinoceros lasiotis</i>),	47
Two-horned Rhinoceros (<i>Rhinoceros bicornis</i>),	47
Rhinoceros <i>simus</i> ,	49
THE HORSE FAMILY (Equida),	49
<i>African or Tiger Horses (Hippotigres)</i> ,	52
Zebra (<i>Hippotigris Zebra</i>),	53
Dauw (<i>Hippotigris Burchellii</i>),	53
Quagga (<i>Hippotigris quagga</i>),	53
<i>Asiatic Horses</i> ,	54
African Wild Ass (<i>Equus æniopus</i>),	54
Onager or Gurkur (<i>Equus onager</i>),	54
Tibetan Wild Ass (<i>Equus hemionus</i>),	54
Domesticated Horse (<i>Equus caballus</i>),	55
The Ass (<i>Equus asinus</i>),	55
Horse of Quaternary Period (<i>Equus curvidens</i>),	56
Tarpan (<i>Equus Tarpan</i>),	57
Kertag or Statur (<i>Equus Przevalskii</i>),	57
Geographical Distribution and Descent of the Odd-toed Ungulates,	58
EVEN-TOED UNGULATES (ARTIODACTYLA).	
Introduction,	61
Group of the Non-ruminant or Many-toed Artiodactyla (Polydactyla),	64
THE HIPPOPOTAMUS OR RIVER-HORSE FAMILY (Obesa),	64
River-horse of Liberia (<i>Hippopotamus liberiensis</i>),	64

b

	PAGE		PAGE
Common Hippopotamus (<i>Hippopotamus amphibius</i>),	64	Grecian Ibex or Bezoar Goat (<i>Capra ægagrus</i>),	106
THE PIG FAMILY (<i>Suida</i>),	66	Domestic Goat (<i>Capra hircus</i>),	107
Wild-boar (<i>Sus scrofa</i>),	67	Angora Goat (<i>Capra hircus</i> , var. <i>angorensis</i>),	108
Red River-hog (<i>Potamochoerus porcus</i>),	69	<i>The Ibex (Ibex), Bouquetins, Steinbocks</i> ,	108
Emgalo or Ethiopian Wart-hog (<i>Phacochoerus æthiopicus</i>),	69	Alpine Ibex (<i>Ibex alpinus</i>),	109
Emgalo of Inner Africa (<i>Phacochoerus africanus</i>),	69	<i>The Sheep (Ovis)</i> ,	109
Babirussa (<i>Porcus babirussa</i>),	71	Barbary Wild Sheep (<i>Ovis tragelaphus</i>),	110
Pigmy Hogs (<i>Porcula</i>),	72	Rocky Mountain Sheep or Big-horn (<i>Ovis montana</i>),	111
Collared Peccary (<i>Dicotyles torquatus</i>),	72	Mouflon of Kamchatka (<i>Ovis nivalis</i>),	111
White-lipped Peccary (<i>Dicotyles labiatus</i>),	72	Kashkar of the Kirghiz (<i>Ovis Polii</i>),	111
Group of the Two-toed Artiodactyla or Ruminants		Argali (<i>Ovis Argali</i>),	112
(<i>Didactyla</i> or <i>Ruminantia</i>),	73	Musimon or European Mouflon (<i>Ovis musimon</i>),	112
THE CHEVROTAIN FAMILY (<i>Tragulida</i>),	76	Domesticated Sheep (<i>Ovis aries</i>),	114
Kanchil (<i>Tragulus pygmaeus</i>),	76	<i>The Ox Group (Bovida)</i> ,	115
Water Chevrotain (<i>Hyammoschus aquaticus</i>),	76	Anoa of the Malays (<i>Probulalus depressicornis</i>),	115
Musk-deer (<i>Moschus moschiferus</i>),	76	Musk-ox (<i>Ovibos moschatus</i>),	116
THE DEER FAMILY (<i>Cervida</i>),	77	<i>The Buffaloes (Bubalus)</i> ,	116
Muntjac or Kidang (<i>Cervulus muntjac</i>),	78	Cape Buffalo (<i>Bubalus caffer</i>),	116
Red Brocket (<i>Subulo rufus</i>),	79	Common Buffalo (<i>Bubalus vulgaris</i>),	119
Common Roe (<i>Capreolus vulgaris</i>),	79	Kerabau Buffalo (<i>Bubalus Kerabau</i>),	117
Pampas Deer or Guazui (<i>Blastoceros campestris</i>),	79	<i>The Bisons (Bison)</i> ,	119
Axis or Spotted Deer (<i>Axis maculata</i>),	80	European Bison (<i>Bison europæus</i>),	119
Sambur Deer (<i>Cervus Aristotelis</i>),	80	American Bison (<i>Bison americanus</i>),	120
Common Stag or Red-deer (<i>Cervus elaphus</i>),	82	<i>The True Oxen (Bos)</i> ,	123
Wapiti or Canadian Stag (<i>Cervus canadensis</i>),	82	Yak (<i>Bos grunniens</i>),	123
Cariacou (<i>Cervus virginianus</i>),	83	Gaur (<i>Bos gaurus</i>),	124
Fallow-deer (<i>Dama vulgaris</i>),	84	Gayal (<i>Bos frontalis</i>),	124
Reindeer (<i>Tarandus rangifer</i>),	84	Burmese Wild Ox (<i>Bos sondaicus</i>),	125
Elk (<i>Alces palmatus</i>),	86	Zebu or Humped Ox (<i>Bos indicus</i>),	126
Canadian Elk, Moose-deer, or Orignal,	86	Tame Breeds of Ox (<i>Bos taurus</i>),	126
THE HOLLOW-HORNED RUMINANTS (<i>Cavicornia</i>),	87	THE GIRAFFE FAMILY (<i>Devexa</i>),	128
<i>The Antelopes (Antilopida)</i> ,	88	Giraffe (<i>Camelopardalis giraffa</i>),	128
Pronghorn Antelope (<i>Antilocapra americana</i>),	88	THE CAMEL FAMILY (<i>Camelida</i>),	129
Chamois (<i>Capella rupicapra</i>),	89	<i>The Camels (Camelus)</i> ,	130
Gazelle (<i>Gazella dorcas</i>),	93	Bactrian Camel (<i>Camelus bactrianus</i>),	131
Sassa Antelope (<i>Oreotragus saltator</i>),	93	Dromedary (<i>Camelus dromedarius</i>),	131
Bleekbok or Urebi (<i>Calotragus scoparius</i>),	93	<i>The Llamas (Auchenia)</i> ,	134
Duyker-bok or Madocqua (<i>Cephalophus mergens</i>),	94	Guanaco (<i>Auchenia huanaco</i>),	135
Chikara or Four-horned Antelope (<i>Tetraceros quadricornis</i>),	94	Llama (<i>Auchenia Lama</i>),	135
Rietbok or Umseke (<i>Reduncus eleotragus</i>),	94	Alpaco (<i>Auchenia Paco</i>),	135
Harnessed Antelope or Guib (<i>Tragelaphus scriptus</i>),	95	Vicuña (<i>Auchenia vicuña</i>),	136
Saiga (<i>Colus tartaricus</i>),	96	Geographical Distribution and Descent of the Even-toed Ungulates,	136
Nylgau (<i>Portax pictus</i>),	97		
Sing-Sing or Waterbok (<i>Kobus ellipsiprymnus</i>),	98	GNAWERS OR RODENTS (<i>RODENTIA</i>).	
Sable Antelope or Swarte-bok (<i>Hippotragus niger</i>),	98	Introduction,	141
Blauw-bok (<i>Hippotragus leucophæa</i>),	99	THE SQUIRREL FAMILY (<i>Sciurida</i>),	144
Leucoryx or Sabre Antelope (<i>Oryx leucoryx</i>),	99	<i>The Squirrels</i> ,	145
Canna, Elen, or Eland (<i>Buselaphus oreas</i>),	100	Brown Flying-Squirrel (<i>Pteromys petaurista</i>),	145
Mendes Antelope (<i>Addax nasomaculatus</i>),	100	Assapan (<i>Pteromys volucella</i>),	145
Koodoo (<i>Strepsiceros kudu</i>),	101	Common Squirrel (<i>Sciurus vulgaris</i>),	146
Caama or Hartebeest (<i>Bubalis Caama</i>),	101	Chipping Squirrel or Chipmunk (<i>Tamias striatus</i>),	146
Indian Antelope or Sassi (<i>Antilope cervicapra</i>),	102	Souslik (<i>Spermophilus citillus</i>),	147
Wildebeest or White-tailed Gnu (<i>Catoblepas gnu</i>),	103	<i>The Marmots (Arctomys)</i> ,	147
<i>The Goats (Caprida)</i> ,	103	Alpine Marmot (<i>Arctomys marmota</i>),	147
Rocky Mountain Goat (<i>Haploceros americanus</i>),	104	Prairie-dog (<i>Cynomys ludovicianus</i>),	148
Markhor (<i>Capra falconeri</i>),	106		

	PAGE
THE DORMOUSE FAMILY (Myoxida),	148
Loir (<i>Myoxus glis</i>),	149
Common Dormouse (<i>Muscardinus avellanarius</i>),	149
THE BEAVER FAMILY (Castorida),	149
Beaver (<i>Castor fiber</i>),	149
THE MOUSE FAMILY (Murida),	153
<i>The Mole-rats</i> ,	153
Common European Mole-rat (<i>Spalax typhlus</i>), .	153
<i>The Hamsters (Cricetus)</i> ,	154
Hamster Proper (<i>Cricetus frumentarius</i>), . .	154
<i>Rats and Mice (Murina)</i> ,	155
Black Rat (<i>Mus rattus</i>),	155
Brown Rat (<i>Mus decumanus</i>),	156
Common Domestic Mouse (<i>Mus musculus</i>), .	156
Field-mouse (<i>Mus agrarius</i>),	156
Long-tailed Field-mouse (<i>Mus sylvaticus</i>), .	156
Harvest-mouse (<i>Mus minutus</i>),	156
Striped or Barbary Mouse (<i>Mus striatus</i>), . .	156
<i>The Voles (Arvicolina)</i> ,	157
Common Field-vole (<i>Arvicola arvalis</i>), . . .	158
Water-rat or Water-vole (<i>Arvicola amphibius</i>), .	158
Lemming (<i>Myodes lemmus</i>),	158
Musk-rat or Musquash (<i>Fiber zibethicus</i>), .	159
The genera <i>Hydromys</i> , <i>Meriones</i> , <i>Gerbillus</i> , .	159-160
THE JERBOA FAMILY (Dipodida),	160
Egyptian Jerboa (<i>Dipus mauritanicus</i>), . . .	161
Jumping-rabbit of Siberia (<i>Alactaga jaculus</i>), .	162
Cape Jumping-hare (<i>Pedetes caffer</i>),	162
Phillips's Pocket-mouse (<i>Dipodomys Phillipsii</i>),	162
Gopher (<i>Geomys bursaria</i>),	162
THE PORCUPINE FAMILY (Hystricida),	163
Common European Porcupine (<i>Hystrix cristata</i>),	163
African Brush-tailed Porcupine (<i>Atherura africana</i>),	164
Tri-coloured Tree-porcupine (<i>Cercolabes villosus</i>),	164
THE SPINY RAT FAMILY (Echimyida),	165
Coypu (<i>Myopotamus coypu</i>),	165
THE DEGU FAMILY (Octodontida),	166
Degu of the Chileans (<i>Octodon Cummingii</i>), .	166
THE CHINCHILLA FAMILY (Chinchillida),	166
Larger Chinchilla (<i>Eriomys chinchilla</i>), . . .	167
Smaller Chinchilla (<i>Eriomys laniger</i>), . . .	167
Cuvier's Lagidium (<i>Lagidium Cuvieri</i>), . . .	168
Vizcacha (<i>Lagostomus trichodactylus</i>), . . .	168
THE AGOUTI FAMILY (Subungulata),	169
Agouti Proper or Golden Agouti (<i>Dasyprocta</i>	
<i>Aguti</i>),	169
Paca (<i>Cœlogenys paca</i>),	170
Patagonian Cavy or Mara (<i>Dolichotis patagonica</i>),	171
Restless Cavy or Aperca (<i>Cavia aperca</i>), . .	171
Capybara (<i>Hydrochœrus capybara</i>),	172
THE RABBIT FAMILY (Leporida),	173
Alpine Pika (<i>Lagomys alpinus</i>),	173
Common Hare (<i>Lepus timidus</i>),	174

	PAGE
Alpine, Mountain, or Northern Hare (<i>Lepus</i>	
<i>alpinus</i>),	174
Rabbit (<i>Lepus cuniculus</i>),	175
Geographical Distribution and Descent of the Rodents,	175

THE EDENTATES (EDENTATA).

Introduction,	180
THE SLOTHS (Bradypoda),	181
Aï or Three-toed Sloth (<i>Bradypus tridactylus</i>), .	182
Unau or Two-toed Sloth (<i>Choloepus didactylus</i>),	183
THE ARMADILLOS (Dasypoda),	183
Giant Armadillo (<i>Prionodon gigas</i>),	185
Six-banded Armadillo (<i>Dasypus sexcinctus</i>), .	185
Pichiciago (<i>Chlamyphorus truncatus</i>), . . .	185
THE WORM-TONGUED EDENTATES (Vermilinguia),	186
Aard-vark or Cape Ant-bear (<i>Orycteropus capensis</i>),	186
<i>The True Ant-eaters (Myrmecophagida)</i> ,	187
Great Ant-eater or Ant-bear (<i>Myrmecophaga</i>	
<i>jubata</i>),	187
Tamandua (<i>Tamandua tetradactyla</i>),	188
Little Ant-eater (<i>Myrmidon didactylus</i>), . . .	188
<i>The Pangolins or Scaly Ant-eaters (Manis)</i> , . . .	188
Long-tailed Pangolin (<i>Manis longicaudata</i>), .	189
Short-tailed Pangolin (<i>Manis pentadactyla</i>), .	189
Geographical Distribution and Descent of the Edentates,	189

THE MARSUPIALS OR POUCH-BEARING
MAMMALS (MARSUPIALIA).

Introduction,	192
THE OPOSSUMS (Didelphyida),	195
Yapock (<i>Cheironectes variegatus</i>),	196
Common Opossum (<i>Didelphys virginiana</i>), . .	196
The Predaceous Marsupials (Rapaces),	197
THE POUCHED BADGERS (Peramelida),	197
Long-nosed Bandicoot (<i>Perameles nasuta</i>), . .	198
Pig-footed Perameles (<i>Chæropus castanotus</i>), .	199
Banded Ant-eater (<i>Myrmecobius fasciatus</i>), . .	199
THE DASYURE FAMILY (Dasyurida),	200
Brush-tailed Phascogale or Tafa (<i>Phascogale</i>	
<i>penicillata</i>),	200
Viverrine Dasyure (<i>Dasyurus viverrinus</i>), . .	201
Tasmanian Devil (<i>Dasyurus ursinus</i>),	201
Tasmanian Wolf (<i>Thylacinus cynocephalus</i>), . .	202
The Fruit-eating Marsupials (Carpophaga), . . .	203
THE PHALANGER FAMILY (Phalangistida),	203
Squirrel Flying-phalanger (<i>Belideus</i> or <i>Petaurus</i>	
<i>sciureus</i>),	203
Vulpine Phalanger (<i>Phalangista vulpina</i>), . .	204
Koala or Native (Australian) Bear (<i>Phascolarctos</i>	
<i>cinereus</i>),	204

The Herbivorous Marsupials (Poephaga),	PAGE 206	THE MONOTREMES (MONOTREMATA).	PAGE
<i>The Kangaroos,</i>	206	Introduction,	216
Ursine Tree-kangaroo (<i>Dendrolagus ursinus</i>), .	207	<i>The Water-mole, Duck-mole, or Duck-billed Platy-</i>	
Tufted-tailed Rat-kangaroo (<i>Hypsiprymnus peni-</i>		<i>pus,</i>	217
<i>cillatus</i>),	207	Water-mole or Duck-mole (<i>Ornithorhynchus</i>	
Yellow-footed Rock-kangaroo (<i>Petrogale xantho-</i>		<i>paradoxus</i>),	217
<i>pus</i>),	208	<i>The Echidnas,</i>	219
Great Kangaroo (<i>Macropus giganteus</i>), . .	208	Long-spined Echidna or Porcupine Ant-eater	
The Root-eating Marsupials (Rhizophaga),	210	(<i>Echidna hystrix</i>),	219
Broad-fronted Wombat (<i>Phascolomys latifrons</i>),	210	Short-spined Echidna (<i>Echidna setosa</i>), . .	219
Geographical Distribution and Descent of the Marsu-		Echidna of New Guinea (<i>Acanthoglossus Bruynii</i>),	220
pials,	211	Geographical Distribution and Origin of the Monotremes,	220
GLOSSARY, explaining the Principal Scientific Terms employed in this Work,		223	
GENERAL INDEX, giving References to the Animals both by their Scientific and			
their Popular Names,		235	

THE PICTURES.

FULL-PAGE PICTURES.

PLATE	To face page
XVI. THE GREENLAND OR RIGHT WHALE (<i>Balaena mysticetus</i>),	16
XVII. THE AFRICAN ELEPHANT (<i>Elephas africanus</i>),	30
XVIII. THE INDIAN ELEPHANT (<i>Elephas indicus</i>),	32
XIX. THE INDIAN RHINOCEROS (<i>Rhinoceros indicus</i>),	46
XX. THE TWO-HORNED RHINOCEROS (<i>Rhinoceros bicornis</i>),	48
XXI. THE DAUW OR BURCHELL'S ZEBRA (<i>Hippotigris Burchellii</i>),	50
XXII. THE HIPPOPOTAMUS (<i>Hippopotamus amphibius</i>),	64
XXIII. THE WILD BOAR (<i>Sus scrofa</i>),	66
XXIV. THE ROE-DEER (<i>Capreolus vulgaris</i>),	78
XXV. THE RED-DEER OR STAG (<i>Cervus elaphus</i>),	82
XXVI. THE FALLOW-DEER (<i>Dama vulgaris</i>),	84
XXVII. THE ELK (<i>Alces palmatus</i>),	86
XXVIII. THE CHAMOIS (<i>Capella rupicapra</i>),	88
XXIX. THE CANNA OR ELAND (<i>Buselaphus canna</i>),	98
XXX. THE KOO DOO (<i>Strepsiceros kudu</i>),	102
XXXI. THE EUROPEAN BISON (<i>Bison europæus</i>),	118
XXXII. THE AMERICAN BISON OR BUFFALO (<i>Bison americanus</i>),	120
XXXIII. THE GIRAFFE (<i>Camelopardalis giraffa</i>),	128
XXXIV. THE DROMEDARY OR COMMON CAMEL (<i>Camelus dromedarius</i>),	130
XXXV. THE ALPINE MARMOT (<i>Arctomys marmota</i>),	148
XXXVI. THE BEAVER (<i>Castor fiber</i>),	152
XXXVII. THE PORCUPINE (<i>Hystrix cristata</i>),	164
XXXVIII. THE AÏ OR THREE-TOED SLOTH (<i>Bradypus tridactylus</i>),	182
XXXIX. THE ANT-BEAR OR GREAT ANT-EATER (<i>Myrmecophaga jubata</i>),	188
XL. THE GREAT KANGAROO (<i>Macropus giganteus</i>),	208

PICTURES IN THE TEXT.

FIG.	PAGE	FIG.	PAGE
131. The Fresh-water Dolphin (<i>Platanista gangetica</i>),	5	143. The Dugong (<i>Halicore Dugong</i>),	21
132. The Inia or Amazon Dolphin (<i>Inia amazonica</i>),	5	144. Manatee of the Amazon (<i>Manatus australis</i>),	23
133. The Common Dolphin (<i>Delphinus delphis</i>),	6	145. The Abyssinian Hyrax (<i>Hyrax habessinicus</i>),	41
134. The Bottle-nosed Dolphin (<i>Delphinus tursio</i>),	7	146. The Brazilian Tapir or Anta (<i>Tapirus americanus</i>),	42
135. The Porpoise (<i>Phocæna communis</i>),	7	147. The Malayan Tapir (<i>Tapirus indicus</i>),	44
136. The Killer-whale (<i>Orca gladiator</i>),	8	148. The Zebra (<i>Hippotigris Zebra</i>),	52
137. The Pilot-whale or Grind (<i>Globicephalus melas</i>),	9	149. The African Wild Ass (<i>Equus tæniopus</i>),	53
138. The Beluga or White Whale (<i>Beluga leucas</i>),	10	150. The Onager (<i>Equus onager</i>),	54
139. The Narwhal (<i>Monodon monoceros</i>),	11	151. The Tibetan Wild Ass (<i>Equus hemionus</i>),	55
140. The Bottlehead or Common Beaked Whale (<i>Hyperoodon rostratus</i>),	12	152. The Tarpan (<i>Equus Tarpan</i>),	56
141. The Sperm-whale (<i>Physeter macrocephalus</i>),	13	153. The Red River-hog (<i>Potamochærus porcus</i>),	69
142. The Rorqual (<i>Balænoptera boops</i>),	15	154. The Emgalo or Ethiopian Wart-hog (<i>Phacochoerus æthiopicus</i>),	70

THE PICTURES.

xi

FIG.		PAGE	FIG.		PAGE
253.	The Brush-tailed Phascogale or Tafa (<i>Phascogale penicillata</i>),	200	261.	The Tufted-tailed Rat-kangaroo (<i>Hypsiprymnus penicillatus</i>),	208
254.	The Viverrine Dasyure (<i>Dasyurus viverrinus</i>),	201	262.	The Yellow-footed Rock-kangaroo (<i>Petrogale xanthopus</i>),	209
255.	The Tasmanian Devil (<i>Dasyurus ursinus</i>),	201	263.	The Broad-fronted Wombat (<i>Phascalomys latifrons</i>),	210
256.	The Tasmanian Wolf (<i>Thylacinus cynocephalus</i>),	202	264.	The Water-mole or Duck-mole (<i>Ornithorhynchus paradoxus</i>),	217
257.	The Squirrel Flying-phalanger (<i>Belideus sciureus</i>),	204	265.	The Long-spined Echidna or Porcupine Ant-eater (<i>Echidna hystrix</i>),	219
258.	The Vulpine Phalanger (<i>Phalangista vulpina</i>),	205			
259.	The Koala or Native (Australian) Bear (<i>Phascolarctos cinereus</i>),	205			
260.	The Ursine Tree-kangaroo (<i>Dendrolagus ursinus</i>),	207			



WHALES AND DOLPHINS

(CETACEA).

Fish-like carnivores without hind-limbs, and having the fore-limbs converted into flippers, the tail in the form of a horizontal fin. The nostrils (blow-holes) are situated on the summit of the forehead, the ill-developed lips are without moustache hairs, the skin is naked, the placenta diffuse, and the teats situated far back in the abdominal region.



Sailors and the common people call these giants of our present fauna simply "fishes," and the form of the body is, in fact, exactly that of a spindle-shaped fish, with a head, often of enormous size, joined directly on to the body without any apparent neck. Behind, the body ends in a horizontal tail, which is composed of a felt-work of horny fibres; while that of the true fishes stands vertically, and is supported by bony or cartilaginous rays. Even the first superficial examination of a living whale enables us to discover immediately that the gills are altogether wanting; that these animals, although living in the water, yet breathe atmospheric air; that they have warm blood, and teats by means of which they suckle their young.

The skin, which is very thick, but composed of a very loose or open tissue, has its meshes filled with large quantities of fat, which also collects between the skin and the muscles. This skin is quite naked, the epidermis or scarf-skin mostly thick and often like a rind. Hair there is none. Only in the embryos do we sometimes see traces of tactile hairs on the upper lip, but these never develop. The head may attain a third of the entire length of the body; the brain-case is round, but the jaws are drawn out in front into a

sometimes broad, sometimes beak-like muzzle.

In the skeleton the prolongation of the jaws forms a flat section, above which the back part of the skull often rises in the form of a crest, but in the living animal the space between the brain-case and the snout is often filled with large accumulations of fat or oil, which gives the head a form quite different from that of the skull.

The structure of the respiratory passages, the complete absence of external ears, and the position of the very small eyes, so far back and so low down, strike us immediately on making a sufficiently close examination of the form of the head. The nose is no longer a smelling organ; the whales are entirely destitute of this sense. The olfactory nerve is reduced to a thin thread. The nose is now nothing more than a respiratory canal. The nostrils open at the top of the skull, sometimes through a single blow-hole in the form of a half-moon, sometimes through two contiguous slits. The cavity of the nose goes vertically downwards, and its communication with the windpipe is effected in a manner quite peculiar. The larynx or anterior portion of the windpipe, with the glottis or slit opening into it, crosses the back part of the mouth, and fits into the lower end of the nasal passage

so accurately as to close it completely. The animal can thus breathe merely by raising the top of its head to the surface of the water, and can swallow its food in the water without a drop of liquid penetrating into the wind-pipe and lungs, since the fragments in their way down the gullet pass round the larynx where it is inserted into the posterior part of the nasal passage. The external passage of the ear (external auditory meatus) opens on the surface of the skin by a very narrow aperture; even in a large whale it is scarcely possible to introduce a goose-quill into the opening. The eyes are often placed so far behind and at the side that they lie immediately behind the corners of the mouth. They are not inclosed in a bony orbit, but only by a very thick white skin. The pupil itself is not larger than in an ox.

The lower jaw forms a more or less expanded pointed arch, or even a longish beak. There is scarcely any joint behind, and the coronoid process, or ascending part of the lower jaw to which the muscles of mastication are attached in other mammals, is almost entirely wanting. We will afterwards return to the dentition.

All these modifications lead to very peculiar arrangements in the structure of the skull, but these we will not enter upon in detail at present. Let it suffice to say that the petrous bone, or bone containing the inner ear, is separate from the other bones of the skull, and the skull itself is not symmetrical, one of the halves, usually the right, being always larger. This want of symmetry is often more marked in one individual than in another of the same species, but always exists.

The neck is indistinguishable in the living animal, the head, which is very broad behind, being attached to the trunk without the slightest appearance of constriction. In the skeleton the usual number of neck-vertebræ, seven, are indeed present, but they soon become fused with one another, wholly or partially. The vertebræ of the trunk have the

processes but slightly developed, and very liable to become detached; those of the tail have no processes. There is never any sacrum, since the pelvis is wanting.

The fore-limb forms a fin, connected with the trunk by a triangular shoulder-blade. The short and usually flattened upper-arm or humerus is entirely buried in the flesh of the body. The bones of the fore-arm, wrist, and hand are firmly connected together by strong sinewy tissues or ligaments without any joints, and are enveloped by a tough firm skin. The whole limb accordingly is movable only at the shoulder- and elbow-joints. The digits are indicated by rows of small rounded bones, often very numerous, and the terminal bones or phalanges are without nails. The hind-limbs are altogether wanting. But in some whales there are found some bones buried in the flesh which are rudiments of a pelvis representing the thigh- and shin-bones, but which never become developed, being found only in the embryo. In most whales there are also to be seen vertical dorsal fins, formed, like the tail-fin, of a skin supported by a fibrous and horny tissue.

The brain is relatively small, but covered with numerous convolutions. In a whale 20 feet in length and weighing 12,000 lbs. the brain did not weigh as much as $4\frac{1}{2}$ lbs. In the small species, like the dolphins, however, it is relatively much larger and in particular much broader.

Salivary glands are absent. Numerous enlargements of the arteries and veins allow of the animal remaining a considerable time under water without the necessity for purifying the blood by breathing. The teats lie in deep folds of the skin on both sides of the anus. The placenta is diffuse, composed, as in the pachyderms, of lobes or cotyledons distributed over the whole surface of the ovum.

The dentition presents very remarkable differences. The teeth are never specialized, always simple, and have only a single root.

In the embryonic condition all the whales have very numerous rudiments of teeth, similar in form and structure to those of reptiles, inclosed in a groove extending along the whole length of the margin of the jaw, but completely covered by the gum. But the further development of these teeth is very different in different cases. In some forms, the true dolphins, they all cut the gum and persist throughout life in very considerable number. There are dolphins with more than a hundred teeth in all. Others, such as the killer-whales (*Orca gladiator*), have a comparatively small number, 44 in all, and in the beluga or white whale the teeth in the upper jaw disappear with age. In others, as in the sperm-whales, the teeth cut the gum only in the lower jaw, while the upper jaw remains without teeth. In the bottle-nosed whales (*Hyperoodon*) only one tooth is developed in each half of the lower jaw. In the narwhal a single straight spirally-twisted canine attains an extraordinary length, especially in males, usually on the left side of the upper jaw. Lastly, in the true or whalebone whales the embryonic rudiments of teeth persist only for a short time, but soon afterwards disappear in order to permit of the development in the palate of peculiar horny plates, known as whalebone, of which we shall speak when treating of that family.

We thus find among the whales both a reduction in the number of the originally very numerous but uniform teeth, and a disappearance of the hind-limbs in consequence of special adaptations. Manifestly all whales had originally a considerable number of teeth; manifestly they had all originally four limbs, the hinder pair of which, however, has got reduced to insignificant traces.

The whales are not exclusively marine forms. Some genera and species inhabit the large rivers of South America and India. But they are all so dependent on an aquatic life that they pretty soon die if cast on the shore. They are remarkably social, always

found in numerous shoals or "schools," and if several of the larger species are nowadays to be met with only singly or in pairs, this fact is traceable to the persecutions to which these animals have been exposed. Except in those cases the whales swim behind one another in long rows, and since they always come to the surface to breathe, and make a great noise in doing so, these shoals can be perceived both by the eye and ear at great distances. Ungraceful and clumsy as these animals appear when withdrawn from the water, they are yet remarkably entertaining by the agility and flexibility of their movements in their own element. Incomparable is the swiftness with which they dart like arrows through the water without any great exertion. No fish can be compared with them in respect of the ease with which they assume all possible positions, turn head over tail, and scorn all obstacles to their progress. One must have seen a shoal of large dolphins with black backs and white bellies, as they are often seen in the northern seas, playing round the ship in heavy storms, diving under the keel, showing sometimes the upper, sometimes the under side, to form any idea of the enormous muscular strength which these animals have at their command.

They migrate through wide expanses of the ocean, and during these rapid journeys the movements of the animals as they follow one another are quite rhythmical. The top of the head emerges for an instant above the water, and at that moment the animal exhales and inhales with a great noise. In the large species the act of expiration produces a column of vapour visible at a great distance, which thus betrays to the fishers the presence of the whales. I have seen large rorquals swimming round our ship at the distance of a rifle-shot, and have been able to satisfy myself that the blow-holes rise entirely out of the water in breathing, and that the appearance of a jet shot up by a fountain begins only at some little distance above the head. This appear-

ance is accordingly produced only by the condensation in the colder air of the vapour expelled from the lungs through the blow-holes. A large whale, which I saw pass my window at Nice daily for three weeks, only shot up an insignificant jet, which often was not visible at all. The air was warmer. Only when the animals are pursued, and begin to breathe while the blow-hole is still beneath the surface, is there any water carried up into the air along with the vapour.

This process of breathing lasts only a few seconds. The head is then again submerged, the back and dorsal fin appear for an instant describing a curve above the surface, and at last the tail fin momentarily appears, but is again immediately submerged while the head is raised anew. A shoal of dolphins swimming close behind one another in a row produces, in a wonderfully deceptive manner, the appearance of a large serpent swimming on the surface of the water by means of vertical undulations.

All whales are exclusively carnivorous and very voracious. Some feed on fish, others on calamaries and cuttle-fishes, others again on crustaceans and molluses. The kind of food is not always in proportion to the size of the ravager; numbers must make up for deficiency in size. The Greenland or right whale swallows pteropods, a small kind of naked mollusc, in tons, and the rorqual pursues shoals of herrings into bays or the shores, and commits frightful ravages amongst them. The small species are much dreaded by fishermen on account of the injury they do to their nets, the large ones are energetically pursued for the oil which they yield.

It appears that the whales propagate their kind at all seasons, for embryos have been found in the mothers at different seasons in the same stage of development. But nothing is known either about the congress of the sexes or the birth of the young. After birth the young follow the mother about for a little, and on the appearance of danger are taken

by the latter, who is ready to sacrifice her life for her offspring, under her fin, as shown in Plate XVI.

We divide the order of the Cetacea into two groups, the **Toothed Whales** (Denticete), which have teeth in the adult forms, and **Whale-bone Whales** (Mysticete), in which the teeth are replaced by whalebone.

THE TOOTHED WHALES

(DENTICETE).

The Dolphins (*Delphinida*).

The toothed whales comprise first of all the **True Dolphins** (*Delphinida*), which have a larger or smaller number of uniform teeth in both jaws and feed exclusively on fishes.

The **Fresh-water Dolphin**, the *Susuk* of the Hindus (*Platanista gangetica*), fig. 131, belongs to this stock. It is found in the Ganges and its tributaries, and also in the Indus, ascends pretty far up into the land, although it is always most abundant near the mouth. It is distinguished from other dolphins by its long thin beak slightly curved upwards, which has along the middle line a longitudinal ridge separating the narrow slits which form the blow-holes. It has about 32 slightly recurved conical teeth, which become longer near the point of the beak. The dorsal fin is in the form of a low triangular lobe. The tail fin is deeply two-lobed. The animal attains a length of only 6½ feet. The back is almost black. It is said to make use of its beak to dig among the cane-thickets on the river-banks. Its fat is used as a salve.

The large rivers of South America, especially the Amazon and the Orinoco, appear to be inhabited by several species of long-beaked dolphins, among which the species called by the natives the **Inia**, **Bonto**, or Amazon Dolphin (*Inia amazonica (goffrensis)*), fig. 132, is the best known. The beak is straight and narrow, and, unlike what we find in other whales, is set with short stiff

hairs. The body is thick, the dorsal fin scarcely indicated, the tail fin large, but only slightly hollowed out behind, the fore-limbs

very long, and very narrow at the end. The blow-hole is simple, and has the form of a horse-shoe with the convexity directed



Fig. 131.—The Fresh-water Dolphin (*Platanista gangetica*).

towards the forehead. There are as many as 70 short wrinkled teeth thickened at the base. These dolphins, which are very abundant in many localities, lead a very noisy

life, and here and there are protected by a number of prejudices and superstitious tales against persecution by the Indians. They attain, like the *Platanista*, a length of only



Fig. 132.—The Inia or Amazon Dolphin (*Inia amazonica*).

6½ feet. The back is bluish, the belly of a rose-colour.

The true Marine Dolphins (*Delphinus*) approach this fresh-water genus in the horse-shoe-shape of the blow-hole, and in the

possession of a long beak with numerous teeth. The Common Dolphin (*Delphinus delphis*), fig. 133, which is found in the ocean, in the Mediterranean, and the Red Sea, is the best-known representative of the

genus. It attains the length of about 8 feet or more, and has an arched brow separated by a prominent swelling from the long flat beak. The body is thickset, spindle-shaped, the dorsal fin sickle-shaped and pretty high, the tail fin scarcely lobed, the fore-limbs short and pointed. The very tough skin has an olive-brown shimmer on the back, and is white below. There are at least 100, some-

times 200, small, conical, and very sharp teeth.

This dolphin is the animal celebrated by fabulists and depicted by artists, the friend of man, who carries the singer Arion to the shore, renders aid to the shipwrecked, draws the chariot of Galatea, and carries the Tritons and nymphs of the court of Amphitrite. Unfortunately all these virtues have

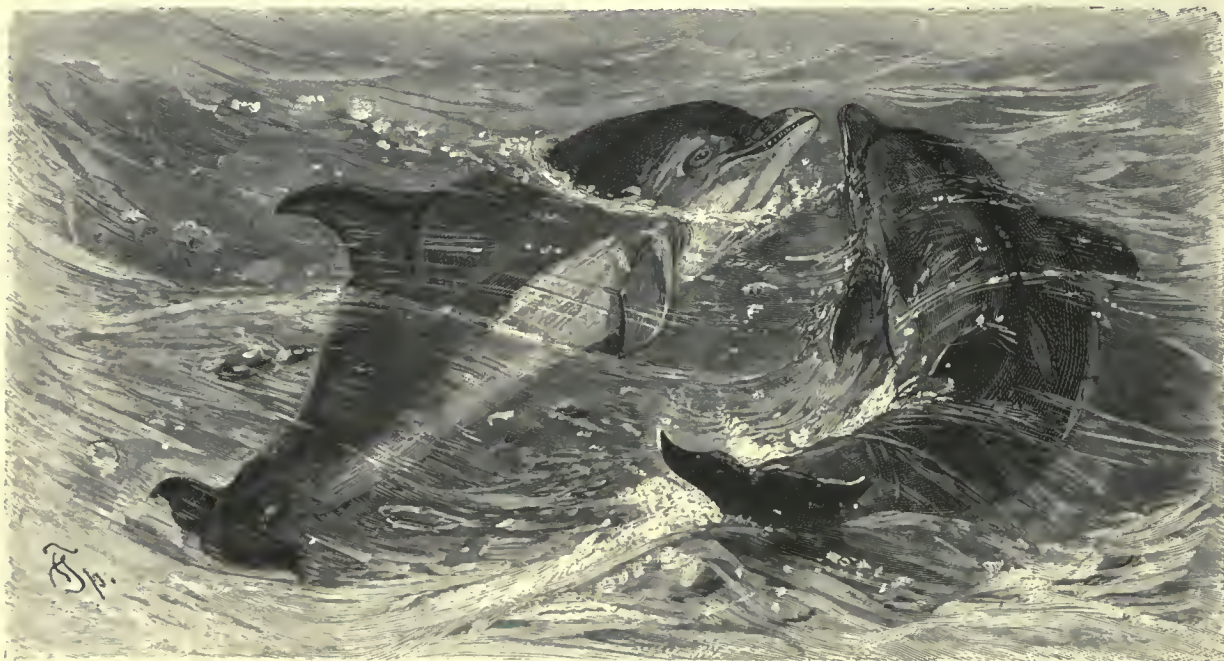


Fig. 133.—The Common Dolphin (*Delphinus delphis*). page 5.

disappeared under the critical eye of modern observers, who no doubt recognize in the dolphin an agreeable travelling-companion, who shortens the idle hours of a long sea-voyage by his graceful sporting round the ship, but who, at the same time, is a terribly voracious ravager, who pursues with fury the fastest swimmers among fishes, herrings, mackerel, water-snakes (*Pelamides*), and flying-fish, darting about after them with the most rapid and abrupt changes in his course, and hastening up to a mortally wounded comrade, not to render him succour, as the ancients said, but to devour him.

With this species is often confounded another much larger one, which attains a length of from 12 to 16 feet. This is the Bottle-nosed Dolphin (*Delphinus tursio*), fig.

134, which has a shorter and more rounded snout, and longer and narrower fore-limbs, and which is of a bluish-black colour above, white underneath. The less numerous teeth are stronger, and get worn away horizontally; a proof that these dolphins, which advance almost exclusively by constantly turning somersaults, add numerous crustaceans to their mostly fish diet.

Other dolphins are characterized by their rounded muzzle, which is not drawn out into a snout, and is not longer than the cranial region of the skull. They are distinguished from the former by having fewer teeth, and these thick and conical, and by having the fore-limbs situated pretty high on the sides, while in the former species they are very low.

The best-known representative of this genus is the Porpoise (*Phocaena communis*), fig. 135, very abundant in the northern seas, in the ocean generally, in the Black Sea and the Sea of Azof, not so common, however, in the Mediterranean proper. The teeth,

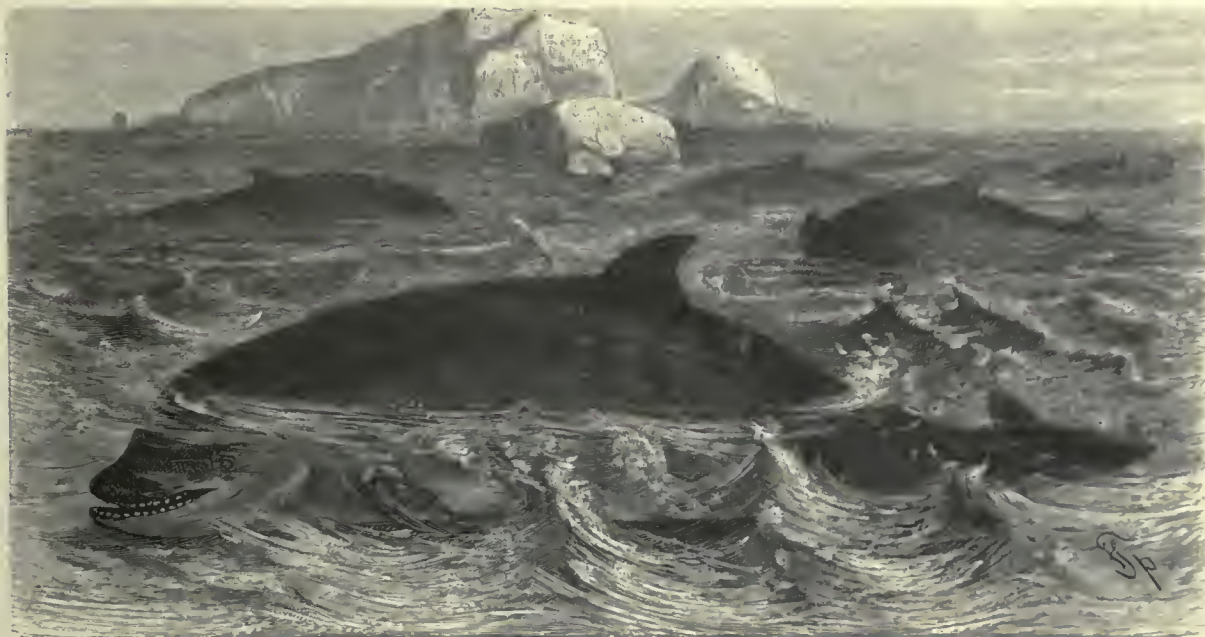


Fig. 134.—The Bottle-nosed Dolphin (*Delphinus tursio*).

which are flattened at the sides, sharp, and somewhat expanded at the end, may be as many as 100 in number, 25 in each half of each jaw. It attains a length of 6 feet,

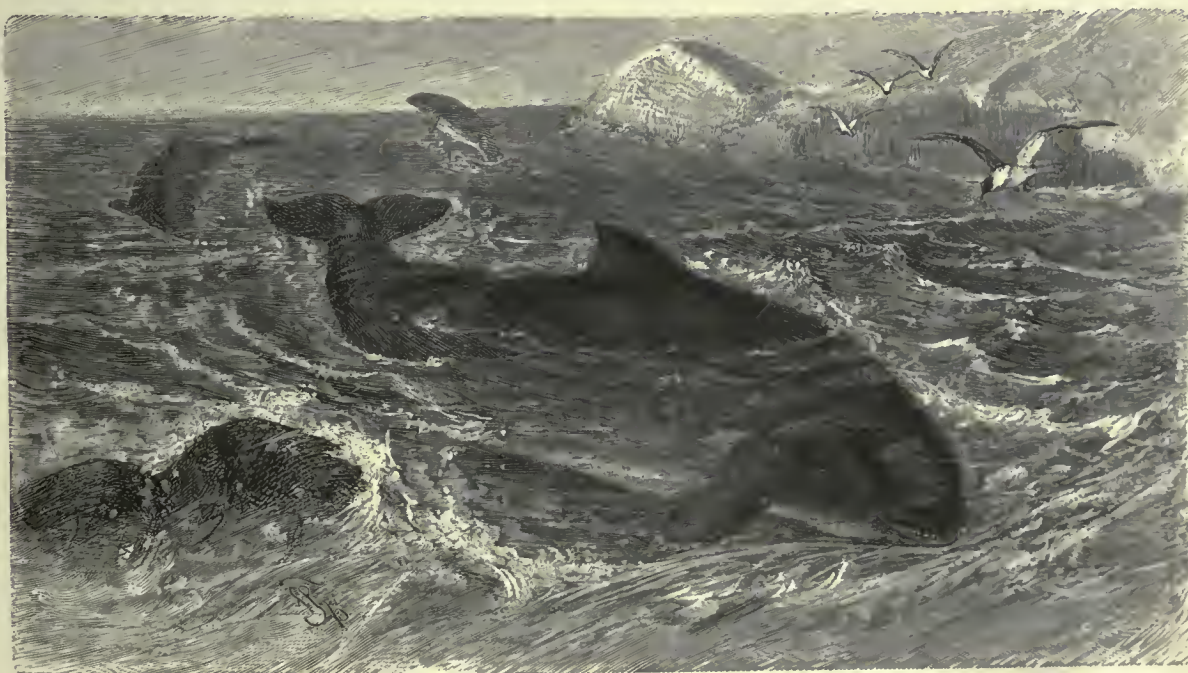


Fig. 135.—The Porpoise (*Phocaena communis*).

is black with a violet-blue shimmer on the back, white on the belly; the fins are black. Its food consists of fish, which it pursues pretty far up rivers, and it is often caught in nets in which it has got entangled in the eagerness of its chase. On certain coasts a considerable number of these are caught for the sake of the oil. Its flesh was for-

merly highly esteemed in France, and was a food allowed by the church in periods of fasting. Belon relates that he saw porpoises sold in Paris on Friday. Porpoise flesh has a very decided taste of train-oil, and at the present day its use as an article of food is confined to the high north.

The number of the teeth is much smaller

in the terrible **Killer-whale** (*Orca gladiator*), fig. 136, the hyaena of the northern seas. This formidable dolphin may attain the length of 26 feet. It has a round head, a short flattened and rounded muzzle, and broad fore-limbs rounded at the end. The dorsal fin is very high and pointed, in the form of a bent sabre; the tail fin large, halfmoon-

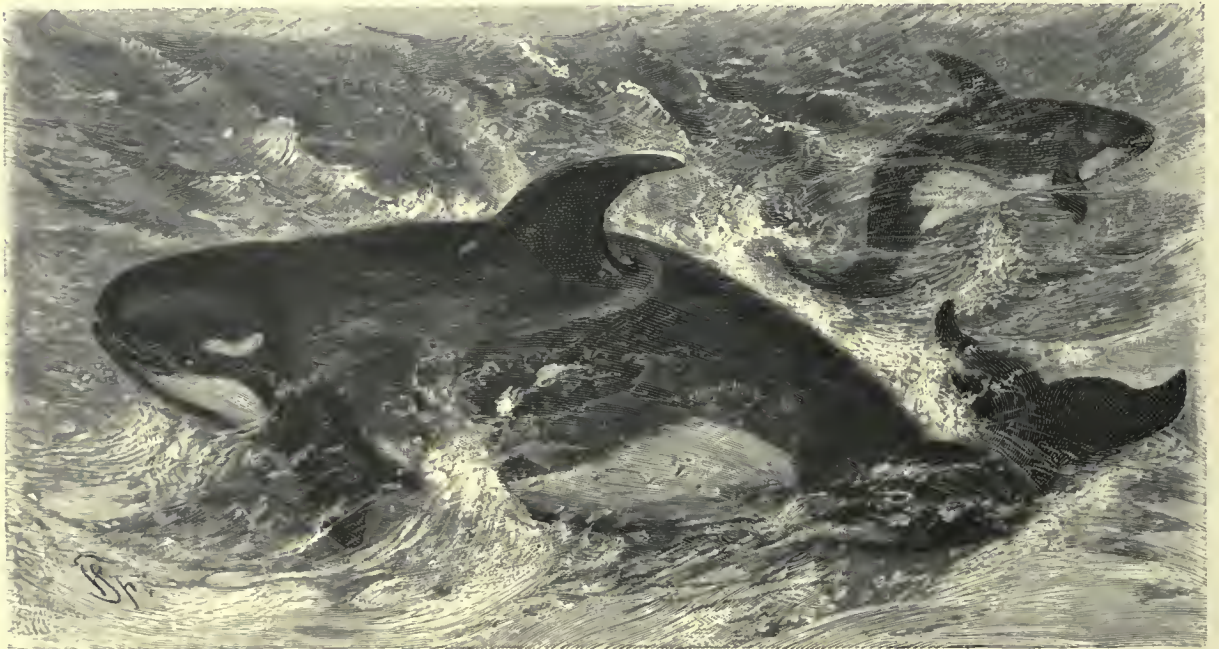


Fig. 136.—The Killer-whale (*Orca gladiator*).

shaped; the body slender, black above, white below, often marked with white patches above the eyes and behind the dorsal fin. The jaws have only 11 very strong conical and slightly recurved teeth in each half, 44 accordingly in all, and these are all situated in front

The killer-whales swim in a line, one behind the other, with a speed that really makes one dizzy to look at them. I have often seen them on the coasts of Norway; they came only in heavy storms to sport round our ship. They are the absolute tyrants of the seas, and work fearful slaughter among the seals and among other cetaceans. Eschricht, a Danish anatomist, who has occupied himself with the Cetacea in a very thorough manner, found a seal sticking in the throat of a killer-whale of about 16 feet in length, which had owed its death to its voracity, since it was prevented from swallow-

ing this seal by having thirteen porpoises and fourteen seals already engulfed in its stomach! The shoals of killer-whales attack the largest cetaceans, and vanquish them. They are said to be peculiarly fond of the fat fleshy tongues of the whalebone whales. Whale-fishers detest them because the whales soon leave the parts where the killer-whales show themselves, and the whalers cannot harpoon the latter because of their rapidity. They are frequently killed with explosive bullets fired from weapons of wide range. Frequently in the eagerness of their pursuit they are carried too far in their chase after fishes and seals, and thus find their way into rivers or get stranded on the shores.

The **Pilot-whale**, the Caaing Whale of the Scotch (*Globicephalus melas*), fig. 137, although a near ally of the killer-whale, is nevertheless widely distinguished from it by its pacific

character, and by the quiet submissiveness with which it often gives itself up to man. An accumulation of fat fills the whole space between the end of the upper jaw and the back of the head, so that the head appears almost round but blunted in front. The body, 19 to 22 feet in length, is spindle-shaped, very thick in the region of the pectoral fins, thin towards the tail, and flattened on the sides, the back thus forming a sort of blunt

keel. The fore-limbs are long and pointed, and attain the length of nearly 5 feet. The dorsal fin is short but pointed, the tail fin deeply lobed. The body is quite black, with the exception of a white stripe along the belly. There is the same number of teeth as in the killer-whale, and they all lie obliquely in the gums so that the small conical crown alone projects. The teeth are very apt to disappear.

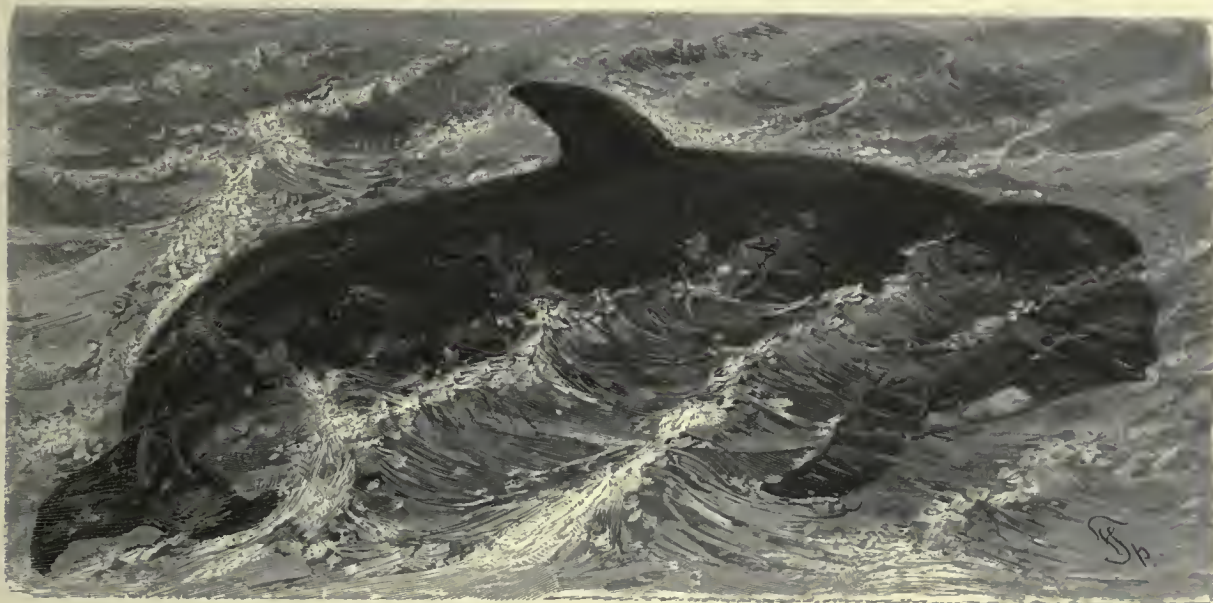


Fig. 137.—The Pilot-whale or Grind (*Globicephalus melas*).

The pilot-whale or *grind*, as the inhabitants of the Faroe Islands call it, always lives in numerous shoals, frequently numbering several hundreds of individuals, and it feeds chiefly on squids, calamaries, and cuttle-fishes, but also on small fish like the herring. It swims slowly, showing the whole length of its back above the water, and it is seldom seen indulging in the violent exercises in which the dolphins and killer-whales take so much delight. The shoal follows almost blindly the movements of an old male who acts as leader. When any of their number are wounded the others collect round them, and do not leave them even though their own life is threatened. The fishermen endeavour to drive the leader ashore, and if they succeed in this they regard the whole shoal as captured.

It appears to be the lot of the pilot-whales

to be stranded on the shores. On the Orkney, Shetland, and Faroe Islands this is a common spectacle, and the inhabitants of the last-mentioned islands would be unfortunate if there were not at least one shoal of pilot-whales stranded during the year. Old laws regulate the capture of this animal. On a signal being given from a fishing-boat that the pilot-whales are approaching, boats are sent out to surround them and drive them towards a bay so as to strand them, and the crews begin the slaughter as soon as they are certain that the animals cannot escape. From two to three hundred are often killed at once. It is calculated that each animal yields a tun of train-oil. The flesh is eaten both fresh and salted and cured like bacon. The fresh meat is compared to coarse beef. The pilot-whale fishery is an important resource for the

inhabitants of the Faroe Islands. On the 7th of January, 1812, a shoal of these animals was stranded at Paimpol in Brittany, after the fishermen had driven the leader ashore, where he bellowed like a bull. The shoal consisted of 7 males, 51 females, and 12 sucklings. One of these animals lived five days in a bay, which he could not leave on account of the shallowness of the water at the mouth.

The **Beluga** or White Whale (*Beluga leucas*), fig. 138, is very like the previous species as regards the form of the head and body, but the flippers are much shorter and the dorsal fin is altogether wanting. With reference to this character the name **Delphinapterus** ("finless dolphin") has been chosen by some as the name of the genus. The dentition is likewise similar to that of the



Fig. 138.—The Beluga or White Whale (*Beluga leucas*).

pilot-whale, only the teeth are not so numerous, and they are very apt to be lost with the advance of age, especially in the upper jaw. The whole body is of a brilliant whitish-yellow colour.

This beautiful dolphin, which may attain a length of 20 feet, and always lives in shoals, is the ornament of the western parts of the Arctic Ocean from Behring's Strait to Greenland. It seldom comes south, and yet in the year 1813 one was observed making itself quite at home in the Firth of Forth near Edinburgh, traversing the estuary at every tide, till at last it was killed by a bullet. Like the pilot-whale the beluga feeds on cephalopods and small fishes. Europeans do

not attack it, and even hail its approach to the ships with joy, in the conviction that whales are to be found near. The Eskimo and Aleutians, on the other hand, esteem the flesh of the beluga very highly, both when fresh and when cured, and they therefore try to catch the animal in nets. According to them the beluga is accompanied by shoals of herring, cod, and flat-fish, which serve it as food.

The **Narwhal** (*Monodon monoceros*), fig. 139, resembles the beluga in the form of its head and body, as well as in the absence of the dorsal fin. The flipper is short and pointed, the tail pretty long, the tail fin very large and deeply lobed. The body is yellowish-

white, mottled with numerous brown spots. The animal attains at most a length of 20 feet, frequents the same parts of the Arctic Seas as form the home of the beluga, and feeds on cephalopods, holothurians, and fishes. The mouth is very small.

What distinguishes the narwhal from all other cetaceans is its peculiar dentition. It

has no teeth in the lower jaw, and in the upper jaw only two straight canines are formed in deep sockets of the maxillæ. In the female these teeth remain through life in the sockets, so that it seems to be toothless, but in the male one of these canines grows straight out to an extraordinary length. There have indeed been found rare examples



Fig. 139.—The Narwhal (*Monodon monoceros*).

of narwhals with two tusks, but in this case they were always unequally developed, and usually it is the left canine which grows out in this manner, while the right remains embedded in its socket. In consequence of this peculiar dentition the want of symmetry which characterizes the skull of cetaceans generally reaches its acme in the narwhal. In the embryos two small incisors and an upper molar are also to be seen, but these are soon lost.

The socket of the canine which forms the tusk is so wide that the premaxilla (the bone which holds the upper incisors when present) comes to form part of its wall. The tusk is straight, and composed so to speak

of spirally twisted strands, and may attain a length of 10 feet. On these tusks, for which high prices were formerly paid, has been founded the fable of the unicorn, which still figures in the English national coat of arms.

Manifestly the tusk of the narwhal is a formidable weapon, but it is apparently used only in battles between males, and not as a means of defence against enemies or for other purposes. Broken or injured teeth are often met with, but the narwhal has never been seen to use its tusk against the killer-whale, which commits fearful ravages among them. All observers are agreed in depicting the narwhals as peaceable creatures and excellent

swimmers, which migrate in numerous shoals when driven on by the ice-masses, by which they often get forced into bays and there hemmed in and suffocated. The Europeans do not often pursue them, but the Eskimo are very eager in the chase of this animal, prizing its flesh very highly.

The Sperm-whale Family (*Physeterida*).

This family consists of those forms which have fully developed teeth only in the lower jaw.

As representative of a group of pretty numerous but little-known cetaceans with only two permanent teeth in the lower jaw,



Fig. 140.—The Bottlehead or Common Beaked Whale (*Hyperoodon rostratus*).

we have selected the **Bottlehead** or Common Beaked Whale (*Hyperoodon rostratus*), fig. 140. This whale, which attains the length of about 26 feet, usually inhabits the Arctic Seas round Greenland, but some individuals have been stranded on our coasts. The first good description of this species was given by John Hunter, to whom it owes its English name, and whose description was based on a specimen caught in the Thames. In winter this whale migrates pretty regularly as far as the waters of Iceland and the Faroe Islands.

The back part of the head is swollen, and this swelling is still further increased by a remarkable accumulation of fat in front of the nostrils between two vertical plates which

stand up like walls on the outer edges of the jaw-bones (maxillæ). The flattened snout is continued in front of this swelling. The Icelanders compare its head to that of a duck. The opening of the mouth is small. In adult animals there are only two large conical teeth in each half of the lower jaw near the front. But in young animals, in each half of the jaw both above and below, a dozen small teeth begin to be formed, but they never cut the gum and are soon re-absorbed. The flippers are very small, the dorsal fin pointed and also small, the tail fin not divided into lobes. The colour is gray, inclining to black, darker on the back than on the under side. The animals feed on cephalopods. In the northern waters they are very eagerly hunted for their

fat, which is of excellent quality, and is largely used for mixing with spermaceti.

The Sperm-whale or Cachalot (*Physeter macrocephalus*), fig. 141, owes its Latin specific name (derived from two Greek words meaning

long-headed) to the monstrous size of its head, which makes up about a third of the whole length of the body, in old males accordingly upwards of 30 feet in length. Along with the right whales and rorquals the sperm-



Fig. 141.—The Sperm-whale (*Physeter macrocephalus*).

whales are the most gigantic members of the fauna of the present world. The weight of an adult animal is estimated at about 200 tons. In a male of only 66 feet in length the short, broad, thick flipper was found to measure only 5 feet 3 inches, while the two-lobed tail fin had a breadth of nearly 20 feet.

The form of this inhabitant of the deep in temperate and warm seas is in the highest degree remarkable. The enormous quadrangular head, so abrupt in front, carries on the upper edge of the anterior surface the S-shaped blow-holes, the canal from which leads obliquely backwards to the bony nasal cavities, which, as usual, are situated on the crown of the skull. The opening of the mouth is very long, but narrow like a furrow,

and the two halves of the beak-like lower jaw are united in front for half their length. The eye is situated behind the angle of the mouth, and immediately behind it again comes the flipper. The top of the back is continued almost in a straight line from the upper part of the head. A long thick fold of the skin of little height forms a rudimentary dorsal fin. The belly is enormous, the body becomes very much thinner towards the large tail.

If we examine the skeleton we have at first some trouble in bringing it into correspondence with the form of the living animal. The skull in fact rises up behind like a wall somewhat as in other cetaceans, and more especially in the bottle-nosed whale. The jaws are

flattened, and the crest on the back part of the head is continued forwards on the edges of the upper jaw so as to form a wide basin. There is no resemblance at all between this skull and the head of the living animal. The enormous cylinder which forms the latter is in fact composed of sinewy tissues forming large cells filled with a fat, which at the temperature of the animal is fluid, but which in the solid form is known as *spermaceti* or *cetin*. It is chiefly for the sake of this fat that the sperm-whale is pursued. A large male may yield as much as twelve tons of spermaceti, for the valuable substance is contained not only in the cells in the head, but in a long cellular tube which runs along the back. The dentition is peculiar. The upper jaw has only rudiments of teeth during embryonic life, but the lower jaw is armed with large, strong, conical teeth, which are at first sharp-pointed but afterwards get blunted, and which are received into corresponding pits in the upper jaw when the creature shuts its mouth.

The sperm-whales, of which there are probably two species, one living in the southern seas the other in those of the northern hemisphere, appear to feed exclusively on cuttle-fishes. Now that we know that enormous cuttle-fishes, gigantic specimens of which are occasionally, though rarely, cast on our shores, are found in almost all seas, this kind of food does not appear so incompatible with the size of the creature as it once did. Though it is chiefly for the spermaceti, as has already been stated, that the sperm-whale is pursued, that is not the sole product of commercial value that it yields. Besides the blubber, which is not very abundant and yields only a mediocre oil, this whale supplies us also with the ambergris which is so highly esteemed in the East as an article to burn as incense and for use in perfumery, and which is not only obtained directly from the animal itself, but is likewise found floating on the waves in clumps about the size of one's fist. It is probable that these fatty masses are formed either in the

bladder or the genital glands of the male. The teeth are also used for the same purposes as ivory.

The chase of the sperm-whale is difficult and dangerous: difficult, because the animal avoids man more carefully than any other cetacean, and remains, on diving, much longer under the water; dangerous, because, when wounded, the creature defends itself with courage, attacks the boats and even the ships, endeavouring to capsize them or to pierce their sides. Numerous cases have been known in which ships have had their sides shattered by sperm-whales which dashed against them with the utmost rapidity, giving a shock with their heads like that inflicted by the ram of an ironclad.

THE WHALEBONE WHALES

(MYSTICETE).

The members of this group are much less numerous than the toothed whales. The head, which is always massive, relatively very large and broad, has a weak lower jaw of elliptical outline, a mouth with an enormous cavity, from the roof of which hang down the horny plates which yield the whalebone, while the lower part of the cavity is filled with an enormous tongue composed almost entirely of fat. The halves of the lower jaw are separate, connected only by a rather loose ligament. In those countries in which the whale-fishery is carried on these bones of the lower jaw are used as gate-posts at field-gates. In the rest of their organization the whalebone whales do not differ very much from the toothed-whales. They all have double blow-holes, the halves of which are separated by a narrow partition.

We have already said that in the embryo numerous teeth which never cut the gum are concealed in a continuous groove running round the jaw. These little teeth, similar in form to those of the sperm-whale, become absorbed as the animal grows.

The roof of the mouth, even in the embryonic condition, is marked with numerous transverse folds, such as are found also in many other cetaceans, and in general in most mammals. Only in the group with which we are now dealing these folds are very numer-

ous and covered with a thick horny epithelium. During the growth of the young animal this horny epithelium goes on developing. It grows down on both sides in the form of a fringe, and at last forms triangular transverse plates, which are attached to the roof of the



Fig. 142. —The Rorqual (*Balænoptera boops*). page 16.

mouth by the small grooved edge, while they present to the exterior a firm, slightly curved edge, and on the interior are broken up into a number of cylindrical fibres, the ends of which form the third side of the triangle which slopes away from the middle line of the palate towards the outer edge of the mouth. Into the above-mentioned groove on the upper edge of each of these plates there sinks a fold of the mucous membrane, which is richly charged with blood-vessels and secretes the horny substance. These closely-packed whalebone plates, the number of which may amount to 200 on each side, the middle ones with a length of about 15 feet, while the edge attached to the roof of the

mouth is only about 1 foot in length, form by their union an arched sieve, in the cavity of which lies the tongue. The water runs through the free fibres on the inner edges of the whalebone, while all the small molluscs, crabs, and fishes are retained.

These enormous animals feed, in fact, chiefly on small swimming creatures, shell-less pteropods, crustaceans, &c., which swarm in the northern seas, and are swallowed by them in tons. The throat of the whalebone whales is pretty narrow; but its narrowness has sometimes been exaggerated, since fish of the size of a herring can be swallowed quite easily. It is known that the herring-fishers are very glad to see the rorquals approach their coasts,

because they know that these whales drive shoals of fishes before them.

Two chief groups are distinguished: the **Fin-backed Whales** (*Balenopterida*), with longitudinal parallel folds extending from the throat to the belly, and a dorsal fin; and the **Right Whales** (*Balenida*), which have neither folds nor dorsal fin.

Fin-backed Whales (*Balenopterida*).

As representative of this family an illustration is given of the **Rorqual** (*Balenoptera boops*, *Physalus antiquorum*), fig. 142, which may even attain the length of 115 feet, and is pretty frequently met with on the coasts of England and Norway. Its true home appears, however, to be further north.

It is the longest, most slender, and most agile of all whalebone whales. The head is relatively short; the body spindle-shaped; the flippers flat, short, and curved; the dorsal fin small, sickle-shaped, placed very far back; the tail broad and half-moon shaped. The rorqual is black above, white below. The ventral folds are bluish-black at the base. The whalebone plates are small, and of little value. The animal has little blubber, and since it is courageous and rapid in its movements, and when in danger attacks instead of fleeing, it is seldom pursued.

The rorqual feeds chiefly on fishes. It is fond of remaining for a considerable time at one place when it finds that the place suits it. At Nice I saw one of this species swim daily backwards and forwards in front of my windows between Antibes and Monaco for weeks together, and sometimes it came so near the shore as to alarm the promenaders on the beach. It had a group of dolphins playing round it, and appeared like a sovereign surrounded by his court. It was afterwards stranded at St. Tropez (French department of Var). In the course of our voyage along the Norwegian coast we were accompanied for several days in the Great Altenfjord by a rorqual of about the length of a two-master,

which approached so near us that we could fire a bullet into its back, which appeared scarcely to tickle it. Without any apparent exertion this monstrous animal could traverse the waters with a rapidity which rendered it difficult for the gulls that swarmed around to follow it. Agile and powerful as it is, the rorqual loves to tumble about after the manner of dolphins. On one occasion when in the latitude of the Lofoden Isles we repeatedly heard thundering noises at a distance as if proceeding from heavy artillery. When we approached we saw a large rorqual, which jumped out of the water, then plunged its head underneath the waves, turned itself vertically downwards, made two or three rapid vibrations with its enormous tail, which we guessed to be at least 20 feet in breadth, and then brought it down with a mighty stroke on the surface, producing a noise which resounded far and wide. It continued this exercise for hours together.

The Right Whales (*Balenida*).

The **Greenland or Right Whale** (*Balena mysticetus*), of which there is a full-page illustration (Plate XVI.) showing a mother with her young one, forms the type of the whalebone whales without a dorsal fin and without ventral folds. In contrast with the rorqual it is very clumsy, thickset, and ungainly. It may attain a length of upwards of 80 feet and a weight of nearly 150 tons. The head is one-third of the whole length. The body is short and round, and decreases in thickness towards the tail very rapidly. The flippers are heavy and thick; the tail only slightly lobed. The right whale is not very agile, and not much given to sports, yet it swims pretty quickly. It repels an assailant with little vigour, except in those cases in which a mother tries to defend her suckling.

This species, to which a very similar but smaller one known as the **Cape Whale** (*B. australis*) corresponds in the Antarctic Ocean,



To face page 270.

PLATE XVI. — THE GREENLAND OR RIGHT WHALE. (*Balena mysticetus*).

has been driven back by the ceaseless pursuit to which it has been exposed since the middle ages to the remotest parts of the Polar seas. The chase is in itself not very dangerous. It sometimes, though rarely, happens that one of these whales capsizes a boat with a stroke of its tail, or carries the boat down with it in diving when the sailors have not succeeded in cutting at the right moment the rope to which the harpoon is attached. The dangers which threaten whalers are those to which all navigators in the icy regions round the poles are exposed, and every year a certain number of ships are lost through being caught and crushed in the ice. In spite of these dangers the pursuit is actively carried on in both the Polar seas for the sake of the train-oil and the whalebone. A Greenland whale 60 feet in length yields 24 tons of oil, and about 32 cwt. of whalebone.

While the Greenland whale formerly advanced as far as the Bay of Biscay it now seldom crosses the 65th parallel of north latitude. The southern whale till about fifteen years ago used to come pretty regularly as far north as the Gulf of Mexico; but now, probably in consequence of the pursuit carried on uninterruptedly in the Pacific Ocean (the Sandwich Islands forming the headquarters of this business), the fisheries already mentioned as carried on in the channel between the island of Trinidad and the mainland of South America have come to an end. Perhaps these whales have also been scared away by the increasing steamship traffic. The Greenland whale also speeds away on hearing any noise. The utmost possible quietness is an essential condition of a successful chase.

[Some peculiarities in the mode of whale-fishing in the Antarctic Ocean at Kerguelen's Land are mentioned by Moseley in his *Notes of a Naturalist on the Challenger* (chap. viii.):—"A difficulty would arise from a whale when struck running through the thick beds of kelp (*Macrocystis*) which everywhere form tangled barriers at a certain distance from shore. This is got over by having large very

sharp knives ready, which are held close beside the line as the boat scuds through the water, dragged by the whale, and cut a clear passage in the weed.

"The whales are killed by means of a bomb, a cylindrical iron tube full of powder provided with a fuse and pointed at one end; at the other, provided with feathers like an arrow. The whole is not unlike a large cross-bow bolt. The feathers are made of vulcanized india-rubber, and when the bolt is rammed into the gun from which it is fired are wrapped round the end of the shaft. As soon as the bolt leaves the muzzle they expand, and prevent the bombs wobbling or capsizing.

"The invention is extremely ingenious. The bomb is fired from a heavy gun from the shoulder, and is good up to about fifteen paces. It is fired into the whale just behind the flipper.

"It goes in, and after a while makes a loud explosion, often killing the beast almost at once. Four kinds of whales are common about Kerguelen's Island, but only one, the southern whalebone whale, is regularly hunted. . . . Similar bombs are now regularly used in the North."]

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE WHALES AND DOLPHINS.

It is difficult, if not impossible, to say anything definite regarding the geographical distribution of the whales. The facility with which these animals traverse enormous expanses of the ocean, and the readiness with which they undertake distant migrations, the difficulty in procuring the necessary material for the distinction of species and genera, the rarity of many types which inhabit the high seas, the numerous accidents by which these animals get carried away out of their usual domain and stranded on shores without one being able to learn whence they have come, and lastly, the persecutions of man, which have driven them away from their original homes, all these circumstances combine to hinder us from arriving at definite conclusions on this subject.

The two great groups of the toothed whales and whalebone whales are distributed over all seas, and if the latter are found

chiefly in the cold Polar seas, we cannot say that they are wholly excluded from the temperate and warm parts of the ocean. The Basques formerly fished the Greenland whale off their own coasts, and till about 1860 there was a whale-fishing station in the channel separating the island of Trinidad from the coast of South America. Only a few individuals, to be sure, were captured every year, but there were always some caught sooner or later in passing through this strait. We can thus assign a restricted domain only to certain species, such as the fresh-water dolphins, the beluga, the narwhal, and the true porpoises, which are confined to the northern seas; but as regards all the other more or less abundant types, we must say that they are found in all seas, and that their presence in large numbers in this or that sea appears rather to depend on secondary causes, such as abundance of food, safety from pursuit, and so forth.

Similar difficulties are presented in investigating the origin of the cetaceans. In the Cambridge Museum there are preserved a few fossil vertebræ belonging to a whale different from all other known species. They were discovered in the diluvial loam of the neighbourhood, but Professor, now Sir Richard, Owen found the appearance of these vertebræ to agree so closely with that presented by the fossil remains of the Kimmeridge Clay of the locality, that he came to the conclusion, a conclusion, however, only very doubtfully expressed, that these vertebræ may have been washed out of Jurassic strata into the diluvial loam in which they were found. If this surmise should be confirmed, then these vertebræ would be the oldest known remains of placental mammals, and the cetaceans would, therefore, have to be regarded as having preceded all other Monodelphia. In that case, accordingly, one might not find the roots of this stock in other orders from which it has been attempted to derive it. This is still an open question.

But with the exception of this still doubtful case the earliest fossil remains of cetaceans that have yet been found belong to the Miocene. Europe has yielded a great number of such remains from Pliocene strata. In the Pliocene period the mouth of the Scheldt appears to have formed a bay in which numerous shoals of whales were stranded from time to time. America has likewise yielded many of the same kind of remains dating from Miocene times. But these remains teach us nothing whatever concerning the derivation of this order, for the large groups of the toothed whales and whalebone whales are already represented in the Miocene, and even the secondary subdivisions are not wanting there. It may accordingly be said that from a palæontological point of view the Cetacea present themselves on their first appearance with all the characters which now distinguish the various groups.

Embryological studies, again, are too incomplete and fragmentary to allow of any well-grounded conclusions on this matter. Anatomy reveals to us a number of points which indicate a low organization related to that of the reptiles. The absence of marrow cavities in the long bones; the spongy nature of the bony tissue generally; the structure of their vertebræ, only imperfectly fused with their apophyses; the arrangement of the bones of the skull, which often exhibits gaps and breaches of continuity; the uniform character of the dentition, which is composed of unspecialized teeth often set in a continuous groove without distinct sockets, the absence of fleshy movable lips, the smallness of the brain compared with the size of the body—all these characters appear to be derived from the reptiles. The fore-limbs, although remaining in a certain measure in the embryonic condition, yet show by their organization, and especially by the large number of the phalanges, or small bones of the fingers, a tolerably close resemblance to those of the large extinct sea-reptiles, the Enaliosaurii,

whose best-known representatives are the *Ichthyosaurus* and *Plesiosaurus*.

On the other hand, we can point to characters which are plainly the result of a retrograde development. The small bones found in the pelvic region in many cetaceans manifestly show that the ancestors of the whales had hind-limbs, which became degraded through a process of special adaptation, and finally disappeared. In all the series of extinct and living mammals and reptiles yet known we cannot point to any type to which the whales could be attached without violence. The *Zeuglodonts*, large marine forms, with hind-limbs, belonging to the upper Miocene and the Pliocene, unite certain characters of the whales with a dentition similar to that of the seals, but it is impossible to regard them as representing the primitive type of the whales, which are contemporary with them or even precede them. The diffuse placenta connects the cetaceans with the ungulates. If it is possible to connect the other placental mammals in more or less direct lines of succession with the old dwarf mammalian types, whether

marsupial or otherwise, which have been discovered in Triassic and Jurassic strata, such an attempt would be altogether impossible with the whales. How could animals with a reptilian dentition be derived from old stems which already possessed a specialized dentition and molars with double roots!

All these questions are insoluble in the present state of our knowledge. The balance inclines at present, perhaps, in favour of a direct connection of the whales with the extinct sea-lizards, the *Enaliosaurs*, on the one hand, and the *Mosasaurs* and *Clidastes* of the Chalk, on the other, although all these have only a single joint-surface at the back of the head (a single occipital condyle), while the whales, like all mammals, have two. If this surmise should be confirmed, it would furnish a beautiful proof of the evolution of the class of the *Mammalia* from various stocks. But for the present these are only doubtful surmises, which, nevertheless, are better supported than those which would derive the whales either from the seals or from the ungulates.

THE SEA-COWS

(SIRENIA).

Fish-like herbivora without dorsal or ventral fins, with a small head and distinct neck, thick lips set with tactile hairs, molars with broad crowns, nostrils at the end of the muzzle, and pectoral teats.



At the first glance we perceive that the body of these inoffensive herbivorous animals resembles that of the whales in its general form, in the possession of a horizontal tail and of flippers, and in the absence of external ears and hind-limbs. As in some whales, one or two small bones are indeed found buried in the flesh in the pelvic region, representing an undeveloped pelvis; but externally no trace of a hind-limb can be seen. In the skeleton some other characters can be pointed out which these creatures have in common with the whales, such, for example, as the fact of the bone inclosing the inner ear being distinct¹ from the other bones of the skull, with which it is connected only by sutures; the simplification of the vertebral column, the absence of a sacrum, and so forth. But there the resemblances end, and with respect to all the rest of their organization these animals are quite different from the whales. The head is small, round, well marked off from the neck, the vertebræ of which are not fused together; the eyes are on the upper surface, not low down at the sides; the muzzle is comparatively small, and surrounded by swollen fleshy lips, on which are

set thick and often very long tactile hairs. The nostrils are situated at the end of the muzzle, and lead into nasal cavities of the same structure as in other mammals. The flippers have indeed the form of oars of uniform width, but are longer than in the whales; the digits have only three phalanges each, and all the bones of the flippers are movable on each other by joints, while in the whales, as we have seen, they are firmly united together by fibrous masses. The teeth are differentiated. In the milk-dentition we can distinguish incisors, no canines, but premolars, to which molars of diverse form are afterwards added, these latter being formed in different genera on the type of those of the ungulates. The form of the skull is altogether different from that of the whales, and the same may be said regarding the structure of the brain and the respiratory and circulatory organs. The teats are situated in the pectoral region. Short stiff hairs are scattered over the thick tough skin.

The sea-cows are often included in one and the same order with the true whales. But when we consider that all the characters which these orders have in common with one another proceed solely from the adaptation to an aquatic mode of life, while the other characters, to be explained by inheritance,

¹ In most mammals, as in man, that bone is fused with the temporal bone, forming what is called the petrous portion of the temporal bone.—Tr.

are different, we must confess that this association is not in harmony with the principles that must be followed in a natural classification.

The sea-cows are large, peace-loving animals which inhabit the gulfs and bays on the sea-coast, and advance up the mouths of rivers far into the interior of the land in order to

seek their food, which consists solely of vegetable substances—various algæ in the sea, leaves, roots, and fleshy fruits in the rivers. Only two living genera are now known. A third, the *Rhytina*, which formerly inhabited the shores of the Behring Sea and other coasts of Eastern Siberia, has been extinct since 1768. Steller has left us a very



Fig. 143.—The Dugong (*Halicore Dugong*).

valuable and complete description of this animal, but that description unfortunately was not accompanied by a drawing. Since the year mentioned no living example of this remarkable species has been seen, although, indeed, in certain districts regular graveyards of bones belonging to it have been discovered.

The Dugong (*Halicore Dugong*), fig. 143, inhabits the Indian Ocean and its bays, the Red Sea, the Persian Gulf, &c., and extends even to Australia. It is a large massive animal, attaining the length of 16 or 17 feet. The pretty thick body becomes rapidly thinner towards the broad halfmoon-shaped tail. The flippers are short and broad, and without nails. The small head ends in a

very thick upper lip, which is very blunt below and behind, and incloses the swollen ball-shaped lower lip. The skin, dark gray on the back but lighter on the under surface, is sparsely covered with short hair. The eyes are pretty small, provided with a large third eyelid or nictitating membrane, and protected by a semicircle of stiff eyelashes above. The hairs of the whiskers are strong and short, almost spiny.

The form of the jaws and the arrangement of the teeth are very remarkable. The very large premaxilla is bent downwards in an adult animal at an angle of 60 degrees, and in the male each half of it carries at its end a strong straight tusk which gets worn away obliquely and thus kept sharp by use. This

incisor is the only tooth in the whole set which takes the place of a milk-tooth. In the female it is not developed. On the inner side of this curved premaxilla the palate forms a sort of narrow groove, which is continued backwards to the posterior nares. Near these openings there are in each half of the jaw large teeth with quite smooth, round or oval grinding surfaces. The lower jaw is very high, but short, and is cut away in front in correspondence with the curve of the upper jaw; and this abrupt and narrow portion, which fits into the above-described groove of the upper jaw, is covered by a rough, thick horny plate, below which there are in the bone four empty sockets from which the teeth have disappeared. In the posterior horizontal part of the jaw there is a varying number of molars similar to those of the upper jaw. In the milk-dentition there are five molars in each half of the jaw, both above and below, but these gradually get reduced to two.

It is still doubtful whether the specimens obtained in the Red Sea and those on the coast of Australia belong to different species or not. In any case these animals have the same habits. They keep to the coasts, seldom ascend the rivers, swim slowly, and allow themselves to sink to the bottom like a lump after coming to the surface to breathe, during which process they show the upper part of their body. Only in moments of danger do they make use of their strength, which is sufficient to enable them to deal vigorous blows with their tail. The mothers keep their young one pressed to their breast under their flipper, defend it to the last, and allow themselves to be killed rather than desert it. The dugongs prefer bays that are not very deep, where they find abundance of sea-weed. They assemble in flocks where they find themselves secure, migrate to fresh parts when they have fully cropped a submarine pasture, but always keep to the coasts during these migrations. They are hunted for their fat, for their hide, and for their tolerably

palatable but rather sweet flesh. They are either harpooned, as in the Red Sea, or are caught in nets and being thus prevented from breathing are actually drowned.

The **Manatees** (*Manatus*) are distinguished from the previous genus by their straight head, thicker body, by having smooth nails on the last phalanx of the four outer digits of the flipper, and by having the tail rounded off to the form of a thick disc. The jaws exhibit only a faint indication of that very pronounced curvature by which those of the dugong are characterized. The incisors and canines are both wanting in adults, but in new-born animals some representatives of these teeth are found, but these soon drop out in the lower jaw, while a single pair of incisors persist in the young animal, but afterwards get lost. The sockets of these teeth are covered, as in the dugong, by a callous horny skin. The molars are never shed, but are gradually developed one after the other as the old ones get worn away by use. In this way a dozen molars may be formed in each half of the jaw, but there are never more than seven or eight in use at one time. These molars are similar in form to those of the tapirs. They all have two or more roots, and the almost cubical crown has on the chewing surface two transverse ridges separated by a deep groove.

Two species of manatees are distinguished, the smaller of which (*Manatus senegalensis*) inhabits the coasts of West Africa and ascends the Senegal and other rivers, while the other larger species (*M. australis*), fig. 144, which attains as much as 10 feet in length, is confined to the east coast of America. This latter species has two geographical varieties, one in the north found all round the Gulf of Mexico, the other further towards the south.

The manatee of the Amazon ascends very high into the interior of the mainland, as high as the rapids. It is eagerly pursued in the large rivers of Brazil and Guiana and

their affluents as well as in the lakes communicating with them. The upper lip is in the form of a rounded knob, and covered with a delicate skin; it probably serves as an organ of touch. The colour of the skin is a dark bluish-gray on the back, but lighter underneath. The few bristles which are scattered over it, and which form a sort of brush on the lips, are of a bright yellow.

The thick but not very dense skin is easily permeated by water, and is used for making cords and whips.

The very abundant fat has a good flavour, and is used both for food and as a material for illumination. The tasty flesh is not unlike pork. The animal is easily harpooned when confined beyond the power of escape in the temporary lakes left behind after



Fig. 144.—The Manatee of the Amazon (*Manatus australis*).

inundations. It has been found possible to tame a few of these gentle and inoffensive animals. They were kept in closed tanks. They came when called to receive their food, and even carried people on their back to the other side of the tank. A German named Kappler, settled in Surinam, who in the course of twenty years had sent forty manatees to various museums in Europe, had a suckling which he reared first with milk and afterwards with bananas. To the training of this little animal, only about three feet in length, he devoted a good deal of attention, and succeeded so well that at last it would even leave the water to cling to the knees of its benefactor. It died during the voyage to England.

The following account is given by Dampier of the method employed in his day (seventeenth century) by the inhabitants of the Mosquito Coast, Central America, in killing and capturing the manatee:—"The Mosquito-men have always a small canoe for their use to strike fish, tortoise, or manatee, which they keep usually to themselves and very neat and clean. They use no oars, but paddles, the broad part of which does not go tapering towards the staff, pole, or handle of it, as in the oar; nor do they use it in the same manner, by laying it on the side of the vessel, but hold it perpendicularly, gripping the staff hard with both hands, and putting back the water by main strength and very quick strokes. One of the Mosquitos (for there go but two in a canoe) sits in the stern, the other kneels down in the head, and both paddle till they come to the place where they expect their game. Then they lie still or paddle very softly, looking well

about them, and he that is in the head of the canoe lays down his paddle, and stands up with his striking staff in his hand. This staff is about 8 feet long, almost as big as a man's arm at the great end, in which there is a hole to place his harpoon in. At the other end of his staff there is a piece of light wood called lobwood, with a hole in it, through which the small end of the staff comes, and in this piece of lobwood there is a line of 10 or 12 fathoms wound neatly about, and the end of the line made fast to it. The other end of the line is made fast to the harpoon, which is at the great end of the staff, and the Mosquito-man keeps about a fathom of it loose in his hand. When he strikes, the harpoon presently comes out of the staff, and as the manatee swims away the line runs off from the bob; and although at first both staff and bob may be carried under water, yet as the line runs off it will rise again. Then the Mosquito-men paddle with all their might to get hold of the bob again, and spend usually a quarter of an hour before they get it. When the manatee begins to be tired it lies still, and then the Mosquito-men paddle to the bob and take it up, and begin to haul in the line. When the manatee feels them he swims away again with the canoe after him; then he that steers must be nimble to turn the head of the canoe that way that his consort points, who, being in the head of the canoe and holding the line, both sees and feels which way the manatee is swimming. Thus the canoe is towed with a violent motion till the manatee's strength decays. Then they gather in the line, which they are often forced to let all go to the very end. At length, when the creature's strength is spent, they haul it up to the canoe's side, and knock it on the head and tow it to the nearest shore, where they make it fast and seek for another; which having taken, they go on shore with it to put it into their canoe, for it is so heavy that they cannot lift it in, but they haul it up in shoal water as near the shore as they can, and then overset the canoe, lying on one side close to the manatee, and roll it in, which brings the canoe upright again, and when they have heaved out the water they fasten a line to the other manatee that lies afloat, and tow it after them. I have known two Mosquito-men for a week every day bring on board two manatees in this manner, the least of which hath not weighed less than 600 pounds, and that in a very small canoe, that three Englishmen would scarce adventure to go in. When they strike a cow that hath

a young one, they seldom miss the calf, for she commonly takes the young one under one of her fins."—*The Voyages and Adventures of William Dampier.*

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE SEA-COWS.

The geographical distribution of the sea-cows plainly shows that the type must formerly have been more wide-spread than it is now. The two species of manatees, which are both in a great measure fresh-water forms, are separated by the whole breadth of the Atlantic, and it is scarcely conceivable that these animals, living only on plants, should at any time have been able to cross this wide expanse of water. The dugong frequents the shores of the Indian Ocean throughout all its vast extent from Mozambique to the north coasts of Australia, and it has only had to cross arms of the sea of no great width in order to extend its domain in this manner. The third genus, the *Rhytina*, as we have already stated, still swarmed in and near Behring's Strait in the first half of last century, the flocks of this harmless creature feeding on the pastures of sea-weed on the coasts of Kamchatka, Northern Siberia, and Western North America, as cows graze on the pastures of the mainland. Thanks to the ferocity of man this species is now completely extirpated.

The sea-cows appear in both hemispheres with the Miocene, and their remains are found in all the deposits which were formed along the coasts during this and the following periods. There are genera very closely allied to the manatees (*Prorastomus* in Jamaica), others which can scarcely be distinguished from the dugong (*Felsinotherium* in Italy), others again which appear to occupy an intermediate position (*Halianassa*, *Metaxytherium*) and which during the Miocene were distributed from the west of France through Germany as far as Vienna. The

type was accordingly well established from the time of the Miocene epoch, and the local isolation of the present species is no doubt to be explained by this wider distribution in former times.

The sea-cows approach the whales in the characters due to special adaptation, and if we take into account only these characters, to which, as already mentioned, belong the form of the body, the presence of a horizontal tail fin, and the absence of visible hind-limbs, we may rank them as a sub-order of the Cetacea. But all the rest of their organization proves clearly enough that the sea-cows are derived from a different stock from the whales, and that by their thick fleshy lips set

with tactile hairs, their dentition, their small distinct head capable of being moved at the neck, the position of their nostrils, the structure of their skull, their brain, and their organs of reproduction, and by a number of other characters which we cannot fully explain here, they are associated with the ungulates. Since the ungulates are already met with in the oldest Eocene strata, while the sea-cows first appear in the Miocene, there is nothing to prevent us from regarding them as a retrograde branch of the former, as representatives of a type which, by a process similar to that which we have demonstrated in the case of the seals and the carnivores, has adapted itself to an aquatic life.

THE ELEPHANTS

(PROBOSCIDEA).

Large animals whose nose is prolonged into a proboscis, which serves as a prehensile and tactile organ, with column-like legs, and feet with five toes united into a mass and covered with flattened hoofs; the upper incisors mostly in the form of tusks, no canines, compound molars; placenta zonary.



This order, much more abundantly developed in former geological periods, is represented at the present day only by the elephants inhabiting the tropics of the Old World. There are now, in fact, only two species, one of which is confined to Africa, and the other to Southern Asia and the Sunda Islands. They are sufficiently different from one another for us to be able to regard them, along with the fossil species, as types of different sub-genera.

The elephants are the most gigantic of land animals, and as such are held in becoming respect by all other creatures except man. These peaceable colossi, which live in bands, often very numerous, and tenderly protect their young up to the age at which they are able to defend themselves, would be able to pass their life unmolested even in the company of tigers and lions if it were not that man attacks them, and even succeeds in taming them.

The external characters are easily seized. The head seems enormous, high and short; the neck short; the huge body raised very high on the massive, straight, columnar legs. The skin is very thick, and has clumsy-looking folds, and is sparsely covered with hairs. These form a tuft at the end of the

tail, which scarcely reaches to the "heel," that is, it must be remembered, to the joint of the hind-legs. The head is striking on account of the unusual development of the brow, the relatively small size of the eyes situated at the sides, the large size of the fan-shaped external ears, and lastly, on account of the trunk, which is always long enough to touch the ground when the animal stands erect. This trunk is formed throughout its whole length of two tubes separated by a middle partition, and consisting of a fibrous continuation of the cartilaginous nose, surrounded by very thick masses of muscle, the fibrous bundles in which intercross in various directions and thus impart an extraordinary degree of mobility to this organ. At the end of the trunk the partition forms a finger-like process, which, like the entrance to the nasal cavities, is covered with a delicate skin. This fleshy, very mobile finger serves chiefly as an organ of touch and prehension, and the elephant makes use of it with wonderful dexterity to pick up even the smallest objects.¹ Under the trunk is seen the trian-

¹ This dexterity, nevertheless, seems often to have been exaggerated. Mr. R. A. Sterndale, author of the *Mammalia of India and Ceylon*, speaks of the difficulty with which an elephant "scrapes up" a coin; and both he and Mr. G. P. Sanderson are incredulous as to the stories of elephants picking up needles.—Tr.

gular opening of the mouth, from which emerge two huge tusks embracing the root of the trunk. These tusks are much longer and stronger in the male than in the female. The root of the trunk represents, so to speak, the upper lip, the side parts of which alone are present. The lower lip is triangular, and is drawn out in front into a pendent point. If the trunk is mainly an organ of touch and prehension it serves at the same time as a means of procuring food and as a weapon of defence. The elephant takes hold of its food and carries it to its mouth with its trunk; when it wishes to drink it fills the trunk with water, which it then squirts into its mouth. A good blow with the trunk is enough to break the back-bone of a tiger which might have the audacity to attack this colossus. Lastly, the different sounds which the animal emits by driving air through this wonderful organ express its feelings of joy and pain.

Behind the short neck with its broad folds of skin comes the huge and thick but comparatively short body supported by the four clumsy and unshapely columns formed by its legs, which appear to have only one joint in the middle, since the upper arms and the thighs are concealed in the flesh. All the bones of the limbs are present in the skeleton in their full number; but the short and plump bones of the toes and the wrist and ankle are so completely surrounded by sinewy and fibrous masses that the foot has the appearance of an enormous pavior's beetle, with a broad, flat, undivided sole. On the front edge of the foot-plate of this beetle, and partly on the upper surface, are found short, rounded, somewhat arched hoofs, which only cover the ends of the toes and are very apt to be lost. With these clod-crushers the elephant tramples to death an antagonist which he has laid low with a blow of his trunk.

Altogether the elephant creates the impression of a huge clumsy creature imposing by its size, but yet not fitted to inspire the same terror as a large well-armed carnivore. One

would at once say that with a little adroitness it would be easy to elude this awkward booby. One might find one's self mistaken, however.

The internal organization of the elephant proves, indeed, the necessity for having a separate order for these creatures, but at the same time reveals many affinities with other orders, and especially with those forms of which the large group of the pachyderms was formerly composed. The skull is very high behind, and thus presents a certain resemblance to that of the whales, a resemblance which would be still more marked if the bones of the forehead were not greatly enlarged by enormous cavities separated by leaf-like bony partitions, and communicating with the cavities of the nose. These frontal cavities are so large that they far exceed in size the cavity of the brain-case, and in an adult elephant the external plate of the frontal bone is about half a yard or more distant from the internal plate adjacent to the brain. The hunters know very well that a bullet shot at the forehead never penetrates to the brain, but remains sticking in these cavities, which are lined with a mucous membrane such as that which lines the cavities of the nose.

The dentition consists of a single incisor in each of the premaxillæ and of a huge and very complex molar in each half of each jaw. The premaxillæ are, in fact, drawn out into huge tubes whose cavities extend very far back, even to the region beneath the eyes. In these sockets there arises and grows on a conical papilla one incisor on each side, which is at first straight and conical. This incisor is present even in the milk-dentition, and at the shedding of the teeth gives place to a permanent tusk, which on emerging from the socket curves outwards and upwards, goes on growing during the whole of life, and often becomes remarkably large in the males, while in the females it is straighter and less massive. It is from these tusks that ivory is derived. The short, high, deeply grooved lower jaw, thick behind and pointed in front,

somewhat similar to that of the dugong, carries no incisors. The molars deserve special attention. These teeth, the grinding surface of which may attain a length of more than 15 inches and a breadth of 4 inches, may be considered as composed of a number of very close-set transversely-placed tooth-fragments, each of which has its own root, pulp-cavity, dentine, and enamel-layer, while all the crowns are united together by a bony cement. These compressed tooth-fragments are clearly seen to be separate at the roots. At first they form separate transverse ridges; afterwards the cement brings these ridges to a uniform level, and when the tooth has emerged from the socket and is brought into operation it gets worn away horizontally so as to present an almost level surface, on which the folds of enamel are not, indeed, very prominent, but yet form very distinct lamellæ. In different species these lamellæ exhibit a characteristic arrangement, and in the fossil genera and species of the Proboscidea we can trace all the transitions from molars with transverse ridges (*Dinotherium*), or with series of tubercles (*Mastodon*), to the more complicated forms of the elephants proper.

This structure has as its consequence the gradual replacement of the molars as they get worn away by use, and this renewal takes place from behind forwards. A second molar, larger and having more numerous plates, is formed in a closed cavity behind the active or functional molar, and this second molar, by a rotatory movement which goes on in the process of growth, pushes out the older one, when it is used up, and takes its place. The elephant thus has in most cases only a single active molar in each half of the jaw, but there may be as many as three: one in front just ready to drop out and worn down to an insignificant stump, a second in full operation, and a third behind just beginning to emerge from the socket. So far as our observations yet go this renewal may be repeated five times in

the Asiatic elephant. The first milk-molar, which cuts the gum at the age of three months and is replaced in the second year, consists of only four plates or lamellæ, while the sixth has as many as twenty-seven. In the fossil proboscideans we can prove a more or less decided tendency to this successive replacement of the molars carried on almost throughout life, in place of the single shedding and renewal which is the prevalent process in other animals.

Among the features of the internal organization we mention first of all the form and size of the brain. The elephant has the largest brain of all living and fossil animals. This brain, besides being larger than that of the whales, exhibits very numerous and complex convolutions. These are two notable facts, which, however, should not be exaggerated. The point of importance lies not in the absolute size of the brain, but in the proportion of its mass to that of the whole body. Now, in proportion to the size of the body the elephant has not a very large brain. To show this it is enough, without making any accurate measurements, to compare the contents of the brain-case of the skull of an elephant and that of a man after both have been sawn through. The development of the convolutions of the brain likewise stands in close relation with the size of the animal. Large animals always exhibit more complex convolutions than small ones of the same family. The brain of the elephant even exhibits some characters which point to a lowly organization. The hemispheres of the large brain (the cerebrum) do not cover the small brain or cerebellum. The stomach is simple, the cæcum enormous, the uterus bicornuate. The elephants are distinguished from the other ungulate animals, except the *Hyracida* or rock-badger family, by their zonary placenta, which is not indeed contracted like that of the Carnivora, but nevertheless admits of the development of a deciduous membrane in the uterus.

In the moist primeval forests of their native

regions the elephants roam about, often in numerous bands. The more abundant is the supply of water the more agreeable is it to the proboscis-bearers, and they often venture up into pretty high and cold mountains, provided they can find there ponds and marshes in which to bathe and cool themselves during the heat of the day. They are fond of a moist heat, but they do not dread the cold if they can only get plenty of food and water. During the day the elephants seek the densest parts of the thickets, or plunge into pools up to their heads in order to protect themselves against the flies and all sorts of parasitic insects which frequently make their abode on their skin. An elephant living in a state of freedom is seldom seen without having its back occupied by African beef-eaters (*Buphaga africana*) and other birds, which render it the service of seeking out these parasites and the larvæ which bore into its skin. Without being entirely nocturnal in their habits a herd of elephants yet rest mostly by day, and set out on the march only at sunset.

The elephant is exclusively herbivorous. All that he can reach with his trunk comes right to him. Still he has his favourite plants. He eagerly plunders certain trees by breaking off thick branches, from which he not only eats the leaves and the buds, but also strips off and swallows the bark, and even eats the wood. The ravages which a herd can commit in the woods, and in sedge and bamboo thickets, as well as in the plantations of the natives, are extraordinary. Not only are the branches broken all along the route selected by such a troop, but even tolerably thick trees are overthrown, and everything is trampled into the ground. The interior of many woods on the island of Ceylon, on the Sunda Islands, and in the interior of Africa is accessible only by the paths which the elephants have made in traversing them. The herds frequently number as many as a thousand individuals, and formerly, before man had com-

menced his disastrous raids, they were, without doubt, much more numerous.

It will readily be understood that such numerous companies of these huge animals must lay waste the region in which they have settled for a time. Moreover, the elephant is essentially a vagabond which continually changes its quarters and even undertakes great migrations, in the course of which it is stopped neither by rivers nor mountains, nor even by sandy plains if they are not of too great size. The elephant swims easily and long without getting tired, merely keeping the end of his trunk above the surface of the water. It climbs among rocks with no little skill, manages to find out the lowest passes in crossing mountains, and knows how to overcome the worst difficulties of the ground. But this dexterity is often prejudiced by an excessive caution. The movements of the animal are in themselves neither graceful nor expert. It is always a very ponderous clumsy creature, greatly impeded by its own massiveness. The trunk alone is worthy of admiration on account of its flexibility, the certainty with which its movements can be executed, and the strength which it can put forth. But otherwise the elephant is not very adroit. Its gait is pretty slow, though the colossus can run very fast when once in full career, but this pace never lasts very long and is always maintained in a straight line. The animal turns only with difficulty, and a leap to the side is usually enough to get men and beasts when pursued out of the reach of its fury.

The elephant is very shy and mistrustful. The slightest noise alarms him, and any kind of artificial hindrance, however insignificant, stops his progress. It is manifestly acquaintance with man that has developed this timidity. The powerful animal, which easily uproots a moderately large tree, allows itself to be kept in by a wretched stake stuck in the earth by man.

The disposition of these giants is very pacific. Observers have never been able to

witness quarrels or serious battles among the herds. Live and let live seems to be the highest law of these troops. Every individual drinks, eats, bathes, and rests according to its own pleasure, while keeping on good terms with its neighbour. The young are guarded and tended in common, are fondled and caressed by all, and are suckled by the females in milk. Only at the breeding season do serious battles take place between the males; and the rejected males, which live as hermits, the so-called "rogue" elephants, alone exhibit a fierce disposition, and are dangerous even to man.

The female remains pregnant for 20 or 21 months. The new-born elephant is about three feet or more in height. It sucks with the mouth, bending back its trunk, and is able to follow the herd at the end of a few hours. The young continue growing till they are about 25 years old, and examples are known of elephants which have lived to be more than a hundred.

The mental qualities which the elephant exhibits in a wild state scarcely surpass those of other social animals, and are certainly inferior to those of the apes and monkeys, while, on the other hand, they far excel those of the generally stupid ruminants. An old male leads the herd with infinite care and caution. It is he who scrutinizes suspicious places, leads the marches, selects the halting-places, and stations the sentinels to ensure the safety of the herd while resting, bathing, or feeding. The herd follows him with a blind confidence, and all the members of it give themselves up to their sports without fear when the leader shows himself satisfied.

It may justly be said that the higher mental qualities of the elephant, which cannot be called in question, have been developed only after he came into contact with man, his sole enemy. It is for that reason that he has an unbounded fear of man, and it is on account of this fear that he allows himself to be easily tamed and employed as a

domestic animal, which still has its value in certain parts, but wherever civilization advances must yield to the ox and horse, whose services in the way of labour are much greater in proportion to the food consumed.

The **African Elephant** (*Elephas africanus*, Plate XVII.) may attain the height of 16 feet. It is easily distinguished by its short, thickset body, supported by long and rather thin legs, by its steep brow, and its enormous flat ears in the form of nearly half-moon shaped discs, which cover the neck and shoulders and touch the nape of the neck as well as the under surface of the throat with their extremities. These enormous fans are almost always in motion, and impart to the animal a quite peculiar appearance according to the position in which it holds them. The brow appears to be less arched than that of the Indian elephant, not in consequence of the lower development of the brain, as some recent writers assert, but because the hollow spaces which we have described in the frontal bone are not so much puffed up. The trunk is pretty slender, somewhat compressed, and has numerous folds which stand out on the edges like flattened scales. The tusks of the males are enormous, and may attain a length of several yards and a weight of 110 lbs. each.¹ The skin is roughly folded, of a dirty slate-blue colour, and almost destitute of hair, which is found in small quantity only on the neck, the breast, and the belly.

At the present day the African elephant, which far excels the Indian in size and strength, and also in wildness, is only the object of unceasing and destructive pursuit, carried on for the sake of the ivory, the tusks. The yield of ivory and the size of the tusks brought to market are gradually

¹ Isolated instances of much heavier tusks are recorded. Officers belonging to the Niger expedition of 1837 reported that a negro chief had shown them two tusks each measuring $2\frac{1}{2}$ feet in circumference at the socket and weighing more than 330 lbs., and Broderip states in his *Zoological Recreations* that a tusk of that weight was sold at Amsterdam. See Von Scherzer, *Das wirthschaftliche Leben der Völker*, p. 366, n.—TR.



To face page 30.

PLATE XVII. — THE AFRICAN ELEPHANT (*Elephas africanus*).

diminishing with the steady diminution in the number of the animals. While in 1810 the tusks exported from Africa weighed on an average about 29 lbs., this average has decreased since then by about one-third.

Though the tusks in both species are pretty much alike, this is not the case with the molars. Those of the African elephant exhibit on the grinding surface at most twelve lozenge-shaped bands of enamel, the middle angles of which almost touch one another. In early years these teeth with their tubercled lamellæ of enamel still unworn resemble in a certain measure those of the mastodons, and it may be said in general that, as regards the dentition, the inferior development of the frontal spaces, and a number of other characters belonging to the skeleton, the African elephant has preserved many archaic forms.

The ancients used to tame this species and employed a large number in their circus games as well as in war. In the time of the Cæsars thousands of elephants were caught every year and sent to Rome to be trained to all the arts for which Asiatic elephants are now used. In our time hunters have begun to send over young specimens to our zoological gardens.

The chase of the wild elephant is not indeed without danger, but cannot be compared in this respect with that of other large animals. The elephant is essentially timid; it flees when it can, and though when wounded it darts with fury on its pursuer, it is not very adroit in its defence, and usually spends its strength in vain. The hunters of various tribes of Inner Africa pursue it on horseback or on foot armed only with a two-handed sword. While one of the hunters keeps the elephant engaged, the others seek to approach him in order to cut through at a stroke the sinews of the foot, or even to cut the trunk itself in two. In other regions the elephants are inclosed in a ring of fire by setting fire to the tall grasses of the steppes, and in other places again they are entrapped in

carefully concealed pits. But all these earlier modes of elephant hunting are gradually giving place to the method introduced by Europeans, that of shooting them with heavy bullets shot from rifles specially made for the purpose. The hunter adopting this method usually follows the elephant on horseback. The ball is fatal only when it strikes behind the ear, the only part of the head at which it can penetrate to the brain, or behind the shoulder-blade so as to reach the heart. The thick, tough hide is often used to cover shields or to make into straps, but in most cases the hunter contents himself with hewing out the tusks, leaving the carcass to the hyænas and vultures.

The **Indian Elephant** (*Elephas indicus*), Plate XVIII., is not so large and has not such long slim legs as that of Africa. The forehead is somewhat depressed in the middle and highly arched at the sides. The ears are much smaller and have the form of paper-cornets with the points hanging down and the upper edge rolled in. The tusks of the male are straighter and not so large. The molars are specially characteristic. The grinding surface exhibits a great number of transverse enamel plates, which form a series of closely adjoining very narrow ellipses, so that one may say that the whole tooth is transversely striped with narrow plates of enamel which are united in pairs at the edges of the tooth. As fossil species are found similar to the African elephant in respect of its dentition, so also are there fossil species the molars of which resembled in structure those of the Indian elephant. Of these the best known is the mammoth (*E. primigenius*), a gigantic species with enormous highly-recurved tusks, which lived along with man in great numbers on the whole of the European continent during the Quaternary period, and at the end of this period perished in heaps in the Polar regions. As has been proved by the discovery of well-preserved carcasses of this species in the frozen diluvium on the

banks of the Lena, these mammoths were covered with a thick fleece, and had long fluttering manes depending from the back and breast.

The Indian elephant is scarcely hunted at all now like the African one for the sake of its ivory, but it is often captured to be tamed and used for the transport of heavy material over marshy and difficult ground where there are no roads. For such work the elephant is admirably adapted by its patience, caution, and skill, and its remarkable strength enables it to overcome the greatest obstacles. In general they are obedient and attached to their masters. But at the time of heat, which occurs at irregular periods, they cannot be trusted, since they are then subject to sudden accesses of fury. Their keepers know very well that the increased excretion of a strongly-smelling oily fluid from a superficial gland behind the eye bodes no good.

It has been said that elephants do not propagate in captivity. That is entirely false. In the countries in which elephants are still frequently used, in which they are attached to the royal train, and even enjoy a kind of worship, as, for example, in Siam, there are breeding-studs of elephants, as we have breeding-studs of horses, and not very long ago a young elephant was born in New York of a female that had been kept for twenty years in a menagerie. But the propagation in this way takes place extremely slowly, so that it is necessary to have constant resort to wild animals to make up deficiencies. In some countries, especially in Ceylon, there are certain castes, in which the business of elephant-hunter is handed down from father to son. Mostly these hunters go out in pairs armed only with a very strong lasso or noose made of buffalo hide. They know how to slink up to an animal unobserved, but instead of severing the sinew at the knee, like the African hunters, one of them throws the noose round one of its feet while his companion fastens the other end to a thick

tree. The captured elephant becomes furious, makes all possible efforts to get free, but is at last subdued by hunger, thirst, and pain; and at the end of a few months the elephant-catchers return in triumph with the tamed elephant, which is often accompanied by a female and her young one. Sometimes also great elephant battues are organized for the purpose of capturing whole troops.

The following notices regarding the elephant, and account of the mode of capturing it in large bands, by G. P. Sanderson, superintendent of government elephant-catching operations in Bengal, will be read with interest:—

“The opinion is generally held by those who have had the best opportunities of observing the elephant, that the popular estimate of its intelligence is a greatly exaggerated one; that, instead of being an exceptionally wise animal, its sagacity is of a very mediocre description. The truth of this opinion no one who has lived amongst elephants can doubt. It is a significant fact that the natives of India never speak of the elephant as a peculiarly intelligent animal, and it does not figure in their ancient literature for its wisdom, as do the fox, the crow, and the monkey.

“One of the strongest features in the domesticated elephant's character is its obedience. It may also be readily taught, as it has a large share of the ordinary cultivable intelligence common, in a greater or less degree, to all animals. But its reasoning faculties are undoubtedly far below those of the dog, and possibly of other animals; and in matters beyond the range of its daily experience it evinces no special discernment. Whilst fairly quick at comprehending anything sought to be taught to it, the elephant is decidedly wanting in originality. To begin with, the elephant displays less intelligence in its natural state than most wild animals. Whole herds are driven into ill-concealed enclosures, which no other forest creatures could be got to enter; and though these enclosures are made immensely strong, and are generally capable of resisting the efforts of any single elephant, they would not for a moment withstand the combined attack of even two or three, much less of a whole herd. But elephants never thus combine to free themselves. I have frequently seen fifty or sixty crowded into a stockade only thirty yards in diameter, the palisades of which would have been of no more account than corn-



To face page 32.

PLATE XVIII. — THE INDIAN ELEPHANT (*Elephas indicus*).



stalks before the rush of three or four of them, but no such rush has been made. More significant still, I have, on several occasions, seen a single elephant in a herd, by a bold dash, burst through the palisade and effect its escape, but I never yet saw any other elephant follow, and the hunters have at once repaired the breach.

"When a herd of wild elephants is secured within a stockade, or *kheddah*, the mahouts ride trained elephants amongst the wild ones without fear, though any one of the wild ones might, by a movement of his trunk, dislodge the men. This they never do. Single elephants are caught by being bound to trees by men under cover of a couple of tame elephants, the wild one being ignorant of what is going on until he finds himself secured. Escaped elephants are retaken without trouble; even experience does not bring them wisdom. Almost yearly, one or two tame elephants of the hunting establishment at Dacca are lost in the jungles by straying, or other accident, whilst engaged in the capture of their fellows. As an example, in December, 1878, an elephant which had been captured three years, and partially trained to hunting, took fright at the fires and guns used in driving a herd, and ran away. Her mahout fell off, and nothing more was seen of her until March last, when we recaptured her after four and a half years' absence, in a herd of twenty-one elephants, 100 miles from where she was lost. She had a calf at heel. When pricked with a spear, and ordered to kneel, she did so promptly, and in three days she, and another reclaimed runaway, were employed in the capture of their fellows. Whilst such facts testify to the docility of the elephant, they tell heavily against its intelligence. . . .

"The government kheddah plan is the most certain and economical method of taking wild elephants. As many as 118 have been secured in one drive by this means. . . . A kheddah party of 370 men having been collected, it marches to the hunting grounds, sometimes 200 miles distant, where a base camp is ready, and where the establishment of tame elephants, generally from 100 to 150, has been collected, together with the stores, tools, and ropes required for the operations. Muskets and rations having been delivered to the men, and religious ceremonies for success having been performed, the hunters enter the jungle. The trackers of the party have probably already marked down a herd, whereupon the hunters approach to within a mile, and then divide under two experienced leaders, one half filing

off to the right, and the other to the left, their object being to enclose the herd in a large circle by meeting beyond it. A man is left at every 30 yards or so along the lines, according to the nature of the ground. The skill with which this movement is effected is very remarkable, as the ground is usually quite unknown to the hunters, and the difficulty of crossing streams and hills, of forcing their way through dense jungle where no path exists, and of gaining the point they are making for without a compass, is considerable.

"The circle, when completed, is often five or six miles in circumference. A large one, with men posted fifty yards apart or so, is more efficient in keeping in a herd than a smaller one with men much closer. Unless plenty of room be allowed to the elephants, they are liable to break through the cordon of guards; but it is a maxim in elephant catching that, the circle having once been formed, a herd can only escape through accident or great carelessness. It usually takes three or four hours to surround elephants. In a couple of hours the hunters run up a thin fence of split bamboos round the enclosure, and clear a path for communication between each others' posts. Their chief duty then is to see that the elephants do not break out of the circle. The animals seldom give trouble during the day; at night large fires are kept up, and shouts and shots are used to drive them back should they approach. The bamboo fencing serves to show the chief hunters, who patrol the circle at intervals, where the elephants have broken out should they escape, so that the particular men who are to blame can be detected. This investment of the elephants may have to be maintained for a week, sometimes for a month, if the elephants cannot be secured in the first attempts.

"The elephants usually give some little trouble for the first two nights, but their conservative nature then seems to lead them to believe that there are set bounds to their wanderings; and unless fodder or water becomes scarce, they seldom try to force the guards. A small herd always gives more trouble than a large one. The former may only be a wandering party from some large body of elephants not far away; it then shows a strong desire to break through to join its companions. A small herd, too, probably has no calves with it, which is a great disadvantage, as it is then restless and quick in its movements. And a herd of a dozen elephants or so may be well in command of one courageous leader; whereas, in a large gathering, timid animals

preponderate so greatly that a panic is easily established, and elephants that might otherwise behave boldly become infected with the general fear. . . .

"On the day following the investment of the herd, the construction of the kheddah, or small enclosure into which the elephants are to be driven, is commenced. It is situated on one of their chief paths (within the circle) and is constructed with the trunks of young trees, about 6 inches in diameter, and 12 feet high, arranged in a circle of from 20 to 50 yards across. Inside, round the foot of the palisades, a trench 6 feet wide and 4 feet deep is dug, the earth from this being thrown up into a bank on the inner side. The trench and bank of loose earth usually deter elephants from attacking the stockade, or should they do so, prevent their employing their full force against it. The palisades are lashed together with canes, and are strongly supported by cross beams and forked supports behind, the whole structure being designed to support outward pressure only. Were elephants to pull the palisades inwards, they would yield at once, but they never use their trunks for this purpose. An entrance of 4 yards in width is left for the ingress of the herd, and a gate, studded inside with sharp spikes, is either slung from the trees overhead, or is made in two leaves, and is pushed to upon the entrance of the herd, by men stationed behind it.

"A stockade of 40 yards in diameter accommodates 100 elephants easily. To guide the elephants into it, two lines of strong palisades are run out from the gate along each side of the path by which the herd is to approach. These guiding wings diverge to perhaps 60 yards across at their commencement, which may be 100 yards or so from the gate. When the whole is completed, the new woodwork is hidden with leaves and branches. The stockade is usually completed in three or four days. The hunters consider Friday the most lucky day for driving, and they make extraordinary efforts to get the stockade ready by that day if possible. The work of the stockade is done by one half the hunters being taken from the large circle from morning till evening daily, as a weak cordon of guards suffices to keep the elephants in during the day.

"All being in readiness for driving a number of men are taken from the original circle, and a smaller interior surround is formed by commencing at the guiding wings of the kheddah, and posting the men until the elephants are again closed. The original circle is, of course, still maintained, in case of the elephants breaking through the inner one. If the

herd be in two or three detachments, as frequently happens, these are quietly driven together, and the whole are then moved forward towards the kheddah. Should they show an inclination to break to the right or left, the men deter them by striking their axes against the trees. When the elephants gain the funnel-shaped approach to the stockade, the men close in from behind, and from the sides, and urge them on with shots and shouts. If the herd suspects danger, and breaks back through the beaters, fatal accidents not uncommonly occur. Sometimes a herd declines altogether to go in the direction of the stockade, owing to their having the wind from that quarter. In such a case a new stockade may have to be constructed, and if that does not succeed, others also. In this way elephants are sometimes kept in a surround for a month. . . .

"When a herd has been driven into the stockade, the gate is closed and barricaded, and men with firebrands and spears repel any attacks upon it or the palisades. But the trench is usually sufficient to deter the elephants from crossing it. On the same, or following day, ten or twelve tame elephants are admitted with a mahout and rope-tier upon each. . . . The mahouts separate the wild elephants one by one from their companions, when their hind legs are tied by men who slip to the ground for the purpose. A rope is then secured round each captive's neck, and to its hind legs, and it is led out and picketed in the forest near. . . .

"The number of wild elephants that can be taken care of is, at the most, 50 per cent more than the tame ones. As each capture is concluded, the wild elephants are marched out of the jungle into open country, for if kept in the forest they continue to be excited by jungle sights and sounds, and to struggle for liberty, whilst flies are much more troublesome to their wounds in the jungle than in the plains. Each batch of new elephants requires a number of tame ones to be detached in charge of it; thus the hunting operations are limited by the number of the latter.

"When a sufficient number of elephants has been taken, the hunters are dismissed, and all elephants under 7 feet in height are sold to merchants who follow the kheddah parties for the purpose of purchasing such. Those above 7 feet are retained for government service, except some males and old females, which are also disposed of. Not more than 30 per cent of the elephants captured are young and strong females, thoroughly suitable for government service."

GEOGRAPHICAL DISTRIBUTION AND
DESCENT OF THE PROBOSCIDEANS.

The geographical distribution of the proboscideans of the present day may be summed up in a few words. They are entirely confined to the warmer parts of the Old World, and while the African elephant inhabits the whole of the mainland of that continent south of the Sahara, the Indian elephant is found everywhere to the south of the Himalayas as far as the frontiers of China, and on the large islands in the south from Ceylon to Borneo and Sumatra. It may be that the elephants from the last-mentioned island form a separate geographical variety, but, if so, this variety is only slightly different from the elephant belonging to the mainland.

The problem becomes much more complicated when we take into account the fossil proboscideans, of which we know with certainty besides the elephants two different genera now quite extinct: the Mastodons with a few tubercled molars, and the Dinotheria with numerous smaller molars, whose crowns have transverse ridges (Zygodonts). To enter more thoroughly into the problem we must study the origin of the Proboscidea, and the relations in which the individual genera stand to each other.

The true elephants have come down to us from the Miocene period, and in particular the Upper Miocene of India. They are accordingly of comparatively recent date, and are not even known in the contemporaneous strata of other countries. In Europe it is not till the time of the Lower Pliocene that we meet with species which approach the African form in the structure of their molars. The Miocene Indian elephants from the Sewalik Hills, from Ava and Perim, belong to a pretty considerable number of species, whose molars form transitions to the mastodons through having their enamel folds notched into the form of tubercles. This

approximation is so close, indeed, that certain species (*Elephas Cliftii*, *E. insignis*), forming the sub-genus *Stenodon*, are considered by some naturalists to be true mastodons. Only in the Pleistocene of the "forest bed" of Cromer, near Norwich, and in the contemporaneous strata on the mainland of Europe and in North America, are there found elephants whose dentition approaches more nearly to that of the Indian species, and since the African type still continues we find the two still living forms almost everywhere together at that time. But in Quaternary times the species of the African type are for the most part restricted to the regions lying round the Mediterranean Sea, while those of the Indian type, and especially the mammoth (*E. primigenius*), are spread over the whole of the European mainland and the whole of Asia north of the Altai as far as the Polar Regions. The elephants of the African type (*E. priscus*, *meridionalis*, &c.) died out earlier than the others. The mammoth, as already intimated, survived to be a contemporary of man, and an allied species (*E. Columbi*) lived in Georgia and Mexico into the Ice Age.

The molars present so many transitional forms not easy to distinguish that we may fairly infer a progressive development of the species from one another. Since the elephants undertake extensive migrations, we are driven to assume that they gradually extended their domain westwards and northwards from India, becoming meanwhile slightly modified in their forms, and that these migrations required a long interval of time, so that the elephants did not reach the centre and south of Europe till Pliocene, nor the north till Quaternary times. The Miocene deposits of India have yielded species from which the types now living can be derived without difficulty. The African elephant still lived beyond a doubt in Malta, Sicily, and Southern Italy during the Quaternary period.

Be that as it may, the astounding fact still remains that enormous accumulations of the

remains of the mammoth, and even whole carcasses with the flesh and skin, have been found even in the most remote islands of the Arctic Seas, and that this extinct species, which furnishes us at the present day from Siberia with much of the ivory of commerce, was adapted, as is shown by its maned woolly fleece, to much colder climates than those of our temperate zone, while our still living almost naked elephants are not met with far outside the tropics. The presence of Quaternary elephants in the United States and in Mexico perhaps finds its explanation in this, that migrations of these animals took place across Behring's Strait, a view supported by the fact that on the islands and coasts of this strait enormous accumulations of remains have been found partly buried under very old glaciers.

The genus *Mastodon* is distinguished from the elephants especially by its tuberculated molars, by having more or less deciduous tusks (incisors) in the lower jaw, and by the absence of air-spaces in the frontal bones. This remarkable genus appeared, in Europe at least, at the time of the Middle Miocene at Simorre and in Orléanais, and prevailed chiefly during the time of the Upper Miocene, when Europe rivalled India in the wealth of species. The Pliocene witnessed a diminution in the number of species. At this stage the genus died out in Europe and the whole of the Old World, while it appears again with the Pleistocene both in North and South America, and evens exhibits several species in the Quaternary strata of that hemisphere. The great mastodon of the Ohio (*Mastodon giganteum*) played a similiar rôle during the Quaternary period in North America to that played by the mammoth in the Old World. The elephants have, without doubt, developed from mastodons, for in spite of all the distinctions which we have mentioned, there are yet transitional forms so closely related to one another that we cannot but agree with Gaudry in saying, "In reality it is impossible

to say at what moment a tooth can no longer be ascribed to a mastodon or must be ascribed to an elephant."

But while we remain confined to the region of well-distinguished species, we must conclude from the fact above enumerated, that the mastodons, having first appeared on the mainland of the Old World, migrated to America towards the close of the Pliocene, and there continued to exist till the beginning of the present period.

The extinct genus *Dinotherium* deviates most widely from the rest of the Proboscidea. The skull so closely resembles that of the sea-cows that many naturalists included the animal in this order before the limbs were discovered. The molars were ascribed by Cuvier to a gigantic tapir, and lastly, the enormous sabre-like tusks set in the downwardly curved lower jaw impart to the animal a quite peculiar aspect. The bones of the limbs discovered at Pikermi and in Bohemia leave no doubt as to the true relationships of the *Dinotheria*; they exhibit very close affinities to those of the Mastodons. The form of the molars with transverse ridges, the so-called zygodont molars, can throw little light on the affinities of the *Dinotheria*, for this form is found also in the kangaroos, manatees, and tapirs, as well as in our elephants. The presence of large incisors in the form of tusks in the lower jaw is remarkable. The Mastodons, the oldest proboscideans, have incisors in both jaws; the elephants, their successors, have them only in the upper jaw, and the *Dinotheria* only in the lower jaw. The *Dinotheria* became extinct at the close of the Tertiary period.

If we can trace back the ancestral stock of our present elephants to the Miocene mastodon of Simorre with narrow teeth, it is impossible for us to pursue it to a more remote antiquity. The mastodons, no doubt, exhibit distant relationships to the ungulates generally, and especially to the even-toed

ungulates (Artiodactyla), but these relations do not suffice to represent any special stock. All the affinities that have hitherto been suggested break down in face of one slight objection, namely this, that the supposed ancestors belong to more recent strata than their assumed descendants. There is only one exception. The members of the genus *Dinoceras*, gigantic animals from the Middle Eocene of Wyoming and Colorado at the foot of the Rocky Mountains, are older than the mastodons. But does that suffice to entitle us to regard these forms as constituting the primitive stock of our proboscideans? I do not believe it. It appears to me difficult

to bring these animals, furnished with horn-like bony excrescences, numerous very small molars, and enormous canines and no incisors, into connection with the proboscideans, in which the incisors play so important a rôle and the canines are always absent.

To sum up, the Proboscidea form a separate order, which has some affinities to the Ungulata, which was formerly spread over the whole breadth of the mainlands of both hemispheres, but which is now in process of rapid decay, since its members are all extinct with the exception of two species living in the tropics of the Old World.

ODD-TOED UNGULATES

(PERISSODACTYLA).

Hoofed animal mostly of large size, usually with an odd number of toes on both pairs of feet, the middle toe being the one that continues the axis of the leg. The thigh-bone has a third trochanter; dentition complete; stomach simple; teats abdominal or inguinal; placenta usually diffuse and composed of separate cotyledons distributed over the whole surface of the ovum.



The animals belonging to this order formed the greater part of the division of the Pachyderms with an odd number of toes of Cuvier, the group of herbivorous Pachyderms of other authors, who do not ascribe so much importance to the structure of the feet as has been done in recent times especially with respect to the fossil series. The genera now living are, in fact, only the greatly thinned and isolated relics of the fossil types, and in order to acquire a proper understanding of the relations of the living Perissodactyla among one another, it is necessary to have recourse to the fossil forms from which they are derived.

We comprise in this order the **Rock-badger** or cony family (*Hyracida*), **Rhinoceroses**, **Tapirs**, and **Horses**, but willingly confess that the rhinoceroses and the tapirs alone have near relations of affinity to one another in the fauna of the present day, while the horses, and in a still greater degree the rock-badgers, appear to be much more divergent types.

The leading character of this order consists in the structure of the feet, which serve for no other use than standing or running, and in which the distal or lower end is dominated by an axis running through the middle toe, to which all the others are from the first sub-

ordinate. We have at the present day not a single five-toed perissodactyle surviving, but the original number of the toes was five, and if we trace the series back to the oldest Eocene strata, we can demonstrate the existence of certain five-toed perissodactyles in these strata, and arrange the forms in stages, showing how by a gradual reduction in the number of toes we arrive at the apparently single-toed foot of the horse. The law according to which these reductions take place is easy to understand. First of all the toes destined to disappear do not develop sufficiently to touch the ground, they become steadily shorter and more rudimentary, while the middle toe gains in importance, and is brought into the same line with the bones belonging to it of the carpus and metacarpus in the fore-limbs, or tarsus and metatarsus in the hind limbs (that is, the bones corresponding in the one case to those of the wrist and palm of the hand, in the other to the ankle and sole of the foot). This process of reduction first affects the first or innermost digit, which disappears before all the others. The fore-feet of the tapirs and rock-badgers still have four toes; the first digit is altogether wanting, but it is at once felt that the fifth digit is already condemned to impotence and tends to vanish. This loss

is completed on all the four feet of the rhinoceroses and on the hind-feet of the Hyracida and tapirs, so that these feet are composed only of the dominant middle toe together with the second and fourth digits. The gradual loss of the latter two digits can be traced in the series of fossil horses. In the fossil genus *Hipparion* they no longer touch the ground, and carry so-called false hoofs, and in our present-day horses they are reduced to two little style-like splint-bones, as they are called, attached to the two sides of the enormously enlarged metacarpal (or metatarsal) bone. This reduction, which converts the limb into a column, leads, as may easily be imagined, to the loss of the ulna in the fore-limb and to that of the fibula in the hind-leg, so that the lower arm and lower leg, each originally composed of two distinct bones, come at last to consist only of the radius (chief bone of the fore-arm) and tibia (shin-bone) respectively.

The limbs themselves are sometimes shorter and more massive, as in the rhinoceroses and the tapirs, sometimes longer, as in the horses; but whatever their special organization may be, one characteristic is always present: the thigh-bone always has below the great trochanter a separate bony process, known as the third trochanter, for the attachment of the muscles. This process often becomes remarkably large, as in the rhinoceros, and since it is never absent it affords an excellent distinguishing character.

What still further distinguishes the *Perissodactyla* is the large number of vertebræ between the neck and the pelvis—of rib-bearing dorsal vertebræ and of lumbar vertebræ. The number of these vertebræ is never less than 22, it may rise even to 29 or 30. In a rock-badger belonging to the Cape I have counted as many as 21 rib-bearing and 8 lumbar vertebræ.

The dentition presents highly archaic characters in the cheek-teeth along with pretty considerable modifications in the front teeth. We always find, in fact, in the first

instance seven cheek-teeth in each half of the jaw, both above and below, and these resemble each other so closely that it is scarcely possible to distinguish premolars from true molars by the form. All these teeth are compound and exhibit on the grinding surface of the crown varied forms of enamel folds, which become more and more prominent as the teeth get worn away by use, and which, at least in the horse series, increase in complexity from ancient to more recent times. The close-set series of cheek-teeth are separated from the front teeth by a larger or smaller interval or diastema. In this front set of teeth there prevails great diversity. The incisors, originally present in considerable number, may become specialized as in the Hyracida, or become deciduous as in the rhinoceroses; the canines, always weak, may become quite rudimentary.

The brain of all *perissodactyles* is not very large, and the hemispheres of the cerebrum always leave the cerebellum uncovered. The brain of the rock-badger shows some very simple convolutions; the hemispheres of the large genera, as is always the case with larger animals, have more complex convolutions. The intelligence of these animals, even of the most perfect, such as the horse, is always very limited. The stomach is simple and relatively small, and shows no tendency to a further subdivision. The intestines, and especially the cæcum, are very long, as in many entirely herbivorous animals.

THE ROCK-BADGER OR CONY FAMILY (HYRACIDA).

This family contains animals of the size of a rabbit, which are so very different from the other *Perissodactyla* in respect of various characters that they may very well be taken to form a sub-order.¹ Formerly these little

¹ By many naturalists they are regarded as constituting a separate order.—TR.

inhabitants of the stony deserts of Africa and Syria were regarded as rodents, and the older zoologists were not a little astonished when Cuvier declared that they had a great resemblance to the rhinoceroses. Their possession of a zonary placenta induced many more recent naturalists to rank them with the elephants. Now that we are acquainted with a considerable number of fossil ungulates of small size, both odd-toed and even-toed, the persistence of a genus, which is about equal in size to such old genera as *Tapirulus*, has nothing so very remarkable about it as appeared to be the case when only the large *Perissodactyla* of the present day were known.

In their external appearance the *Hyracida* resemble small marmots, the bobaks of the Russian steppes, and the prairie dogs of North America (*Cynomys*). The short fat body ending with a thick head, pointed in front and supported by two pairs of short slender limbs, while at the other end there is only a short stump representing a tail, is clothed with a fine thick silky fur of a yellowish-gray colour, which is darker on the back than underneath, and is somewhat shaded round the eyes and mouth. The muzzle is that of a rodent, the upper lip is cleft in the middle, the eyes are small and prominent, the ears rounded, almost concealed under the hair. The weak and short feet have four toes in front and three behind, and these toes are united down to their extremities by skin and are covered with small slightly arched hoofs, with the exception of the inner toe of the hind-foot, which carries a small claw. The sole of the foot is covered with a firm, rough naked skin divided into several lobes by means of deep furrows. The *Hyracida* can make use of these little cushions and furrows for the production of vacuums which act as suckers. In this manner they cling to the smooth surfaces of the rocks, in the clefts of which they have their retreats. They climb just as easily as geckos, and attach themselves like tree-frogs to smooth surfaces.

What is most striking in the skeleton of these little animals is the very large number of dorsal and lumbar vertebræ, the fused tail vertebræ, the structure of the feet, which resemble those of tapirs on a small scale, the remarkable width of the skull between the eyes, and the great height and breadth of the posterior half of the lower jaw.

The dentition is distinguished by an approximation to that of the rodents, indicated mainly, indeed, in the incisors, but made still more marked by the entire absence of canines in both jaws. The development of a large rootless curved incisor in each half of the premaxilla reminds us of the rodents. But these incisors present, not one, but two external surfaces covered with white enamel, while the internal surface is merely formed of dentine. A transverse section of one of these continuously growing incisors exhibits the form of an equilateral triangle, and as the tooth gets worn away by use it always shows two cutting edges, which unite in the middle in a point corresponding to the angle at which the enamel surfaces meet one another. In the milk dentition there is a second pair of quite small incisors, which are soon shed and are never replaced. The lower incisors are four in number, and are very closely set at the fused symphysis of the halves of the lower jaw. They have the form of long compressed blades lying obliquely and worn away transversely.

Behind the incisors there follows a diastema in place of the canine, and afterwards there follow seven, or even eight, cheek-teeth in each half of the jaw, and these, while all very similar in form, increase in size from before backwards. There are, in fact, four premolars and three or four true molars. The upper cheek-teeth are larger than the lower; both above and below each tooth seems to consist of two halves. In the upper jaw each half has an internal heel surrounded by a strip of enamel, and both heels are united by a strong external serrated enamel

plate. In the lower jaw each cheek-tooth is formed by the union of two half-moon shaped parts with the convexity to the outside. These molars resemble those of the

fossil Palæotheria. Dental formula: $\frac{1 \cdot 0 \cdot 7-8}{2 \cdot 0 \cdot 7-8}$
= 34-38 teeth.

The largest species of the genus Hyrax, the Cape Daman (*H. capensis*), which the Dutch settlers call Klippdass, that is, rock-badger, attains a length of 15 or 16 inches.

Like the Syrian Hyrax (*H. syriacus*), which is known in the Hebrew Scriptures by the name of Saphan (in the authorised version Cony), and the Abyssinian hyrax, the Ashkok of the natives (*H. habessinicus*), which is shown in fig. 145,



Fig. 145.—The Abyssinian Hyrax (*Hyrax habessinicus*).

this animal is found in large companies inhabiting stony deserts, where it can easily find retreats amongst fragments of rock, and has abundance of savoury plants for its food. These companies behave very much as marmots do. They come out of their holes and corners only after they have cautiously examined all round to see that there is no danger. They sit upright on the watch, never go very far from their holes, and give warning of danger by means of a sharp whistling sound. They bring forth only two young ones at a time, but these soon become independent of their mother, and would soon swarm all round if it were not that many of them, in spite of all their caution, become the prey of carnivores. They are delightful little creatures, always good-humoured, agile in their sports, but rather lazy where food is abundant, and, according to the reports of travellers, live

notwithstanding their timidity on good terms with ichneumons and large lizards. The flesh is similar to that of the rabbit, and here and there is much liked and eaten.

Although in most species there is a complete adaptation to a life among the rocks, it is not to be inferred that this is universally true of the group. There are, in fact, in Mozambique and in the interior of Africa certain species out of which the genus Dendrohyrax has been formed, a genus scarcely distinguishable indeed by any essential characters in the dentition or in the structure of the limbs, but one of which the species pass their life on trees, pairs building nests for themselves in holes in the trunks, and, in short, behaving altogether

as climbing animals. The structure of the extremities already described facilitates in these species the climbing even of straight stems. It is a remarkable example of adaptation to a tolerably diverse mode of life, but one which is rendered intelligible by the relations that may have subsisted between the essentially arboreal Prosimii and their supposed ungulate ancestors.

THE TAPIR FAMILY

(TAPIRIDA).

The family of the tapirs has originated from one of the oldest mammalian stocks, one that was distributed in Eocene times over the whole earth.

The Tapirs (*Tapirus*) are clumsy, massive, short-legged animals of about the height of an ass, but with the general appearance of a pig, from which, however, they are at once

distinguished by the structure of the feet, these having four hoofed toes in front, three behind. The longish head with pretty high brow has a certain resemblance to that of a pig in the development of a short proboscis which hangs down over the muzzle. This proboscis is almost naked, with a round

extremity pierced by the nostrils, and serves mainly as an organ of touch. It is constantly in motion. The tapir sniffs and feels objects with it, and even employs it to press things into its mouth; but it cannot use this proboscis as the elephant does his, and in particular it drinks directly through the



Fig. 146.—The Brazilian Tapir or Anta (*Tapirus americanus*).

mouth instead of squirting into its mouth water which it had previously sucked up into this proboscis. In some species the partition between the nostrils terminates in a small finger-like process as in the elephants. The ears are always straight, in the form of pointed paper-cornets. The neck is short, the belly round and large, the tail rudimentary. The last phalanges of the toes are inclosed in flat rounded hoofs, which all touch the earth. The pollex or first (innermost) toe is wanting in the fore-feet, and of the other four toes the fifth or outermost is the shortest, while the middle toe exceeds in length and size the second and fourth on each side. The hind-feet have only three toes,

namely, the second, third, and fourth digits. The hallux or innermost digit and the fifth digit are wanting.

In the skeleton we observe the massive form of the bones, the large number of rib-bearing vertebrae (eighteen), the third trochanter on the thigh-bone, and the peculiar form of the astragalus (the ankle- or sling-bone)—all characters common to the Perissodactyla generally. The skull is elongated, and has its height increased behind by a well-marked ridge or crest running along the middle line longitudinally (sagittal crest). In the ordinary tapirs the nasal bones, which are sometimes very short, form an incomplete roof triangular in form extending horizontally

over the cavity of the nose. They are very unequal in size, and are attached at a rather open angle to the very narrow forehead. In the genus *Elasmognathus*, which has been separated from the true tapirs, the structure of the nasals approaches that seen in the rhinoceroses. The nasal roof in this case is much larger, is arched, and supported by a long partition.

The dentition is very characteristic. In both jaws there are six incisors, three on each side; but while in the lower jaw these incisors are chisel-shaped and diminish in size outwards, those of the upper jaw, on the contrary, are conical, massive, pointed, and assume altogether the appearance of strong sharp canines. The true canines are very small in the upper jaw; in the lower jaw, on the other hand, furnished with a short, strong, sharp crown. In both jaws these teeth are separated by a wide interval from the cheek-teeth, of which there are seven above, six below, in each half of the jaw, all indistinguishable in form and structure. They have almost quadrangular crowns, which are often so deeply divided by a transverse fissure that they seem to be composed of two blades set behind one another. In the lower jaw this so-called zygodont structure of tooth is most marked, since the ridges are very straight and appear to be completely separate, while in the upper cheek-teeth they are connected externally by a strip running length-ways.

These creatures are inoffensive vegetable-feeders, which live in families, seldom forming small troops, and roam about especially in morasses and in moist forests abounding in streams and pools. They are somewhat nocturnal in their habits, sleeping by day, while by night they go out in search of tasty plants, roots containing plenty of starch, and fruits; they are very timid, and when danger threatens at once seek refuge in the water, where they swim and dive with great facility. They are fond of diving to the bottom like hippopotamuses. They bring forth one or

two young ones at a time, and these have a striped skin similar to that of porkers. The females are larger than the males.

Two genera can be distinguished. The **Brazilian Tapir**, the **Anta** of the natives (*Tapirus americanus*), fig. 146, belongs to the genus of the true tapirs, with a cartilaginous nasal septum. The proboscis is cylindrical at the end, the finger-like process but slightly developed, the colour of the skin brownish-gray, rather darker along the middle line of the back. On the neck there is a sort of mane, composed of short stiff hair. In other respects the covering of hair is similar to that of a pig, being composed of thinly-scattered adpressed bristles.

The animal lives in the low marshy forests of South America, hides by day, forms paths by which it regularly passes and repasses in the thickets, wallows in the marshes and the mud, is remarkably timid, and endeavours to make its escape at the least sound, either plunging into the water or rushing blindly through the underwood. Only in defending their young do the mothers become furious, and dart violently against the hunters and dogs that attack them. In their own country tapirs feed solely on vegetable matters, and are just as eager as ruminants in searching out salt pools and ponds. The large felines, jaguars and cougars (pumas), pursue the tapir with not less eagerness than man, who finds his flesh, which is somewhat like beef, very much to his taste, and in addition makes an excellent thick leather out of his hide. The anta is often kept in zoological gardens, where he thrives pretty well if only supplied with plenty of water and mud in which to bathe and wallow, and with a good warm crib for winter.

Altogether the tapirs are harmless creatures, which love rest and quiet, show little attachment to their keepers, are as fond as pigs are of being scratched, and live on good terms with their fellows, but do not inspire visitors with any great interest.

The Malayan or Shabrack Tapir, the Maiba of the natives (*Tapirus indicus* (*malayanus*)), fig. 147, is distinguished from the Brazilian only by its rather shorter proboscis flattened underneath, by the less abrupt profile of the head, by the absence of the mane, and by the colour and markings of the skin. The whole body is very dark with the exception of the

hinder part, which is of a dirty-white colour, and makes it appear as if the whole of the body from the shoulders to the root of the tail and the top of their thighs were covered with a shabrack or horse-cloth fastened under the belly. This rare species, found chiefly on the Malay Peninsula and the island of Sumatra, was first made known to science in



Fig. 147.—The Malayan Tapir (*Tapirus indicus*).

1820. A few specimens have been brought to Europe, but they have not lived long.

An American species, the Andes or Hairy Tapir (*T. Roulinii* or *villosus*), has a still more sloping forehead than the previous one, very thick and dense hair, quite black, with an indistinct whitish patch on the lips. By this development of a woolly covering the species has adapted itself to a life in the high valleys of the Cordilleras at a height of 10,000 feet and more, where severe winters prevail.

Finally Baird's Tapir (*Elasmognathus* (*Tapirus*) *Bairdii*), of a uniform dark brown, with white lips and without a mane, has only recently been discovered in Guatemala and on the isthmus of Panama. This tapir is distinguished in a very marked manner from

the others by the very level brow like that of a boar, by the bony septum of the nose, and by the more delicate and narrower hoofs. The structure of the nose causes the skull to resemble that of the following family.

THE RHINOCEROS FAMILY

(NASICORNIA).

At the present day this family consists of only a single genus, *Rhinoceros*, within which subordinate groups have been formed in accordance with the degree of persistence in the incisors, the presence or absence of a second horn, or even the greater or less thickness of the hide.

All rhinoceroses are huge, heavy, clumsy

animals, with bent legs so short that the belly seems almost to drag on the ground, extremely ugly in appearance, with a rather surly temper generally, and during accesses of fury terrible. They are confined at the present day to the tropics of Africa and India, and present specific differences in different localities.

The head is of moderate size, we may even say small in comparison with the huge body; it is greatly elevated behind. Above, at the back of the head, there are long ears in the form of pointed paper-cornets with a narrow thickened rim. The small eyes are placed at the side, the long projecting snout is arched above, and on this arch stands a horn of variable size, or sometimes there are two horns one behind the other. These horns, which are borne on very strong upwardly-curved nasal bones, are composed solely of fused horny fibres, and their texture is exactly like that of the hoofs or the hollow horns of oxen. But they are distinguished from the latter in that they have no bony core, being quite solid and connected only with the skin. The nasal bones are only wrinkled and spongy at the parts where these horns are attached not very firmly. The horns readily come off a few days after the death of the animal, through the destruction of the vessels and the horn-pulp. In certain districts these horns still have a considerable value. They are used to make cups, which have the reputation of destroying the efficacy of poisons poured into them.

The jaws and opening of the mouth are enormous, the lips thick, and especially the upper lip, which is covered with a very thin skin, and is produced in the middle into a finger-like prolongation, which enables the animal to seize the twigs and stems of plants on which it feeds. The neck is usually thicker than the head and surrounded by broad folds of skin, the belly very thick, the tail short, and ending in a tuft. The legs cannot be better described than by comparing them to those of a badger-hound, so twisted and unshapely are they. They terminate in three

toes, which are placed very close together, covered with arched hoofs, and which all touch the ground. Behind these hoofs there is a broad callous sole. The very thick tough hide is highly valued for the making of shields, straps, cords, and whips. In living animals it presents two very remarkable modifications, which have even been employed for the grouping of species. In the Asiatic forms there are scattered over it broad shield-like plates composed of firmer parts, which are connected together by more flexible folds all running in the same direction. The animal appears to carry a coat of armour composed of several pieces, admitting of a certain amount of mobility at the neck, shoulders, and hips. In the African species, on the other hand, the hide, though far from thin, is yet more flexible, adapts itself better to the outline of the body, and presents a smooth surface, instead of exhibiting, like the armour-clad forms, as we might call them, a number of knobs and bosses, which have a distant resemblance to the inequalities in the shields of the armadillos. Usually this skin is quite naked; only a few hairs are found on the edges of the ears and at the end of the short tail, where they form a tuft which never reaches down to the hollow of the knee. The Quaternary rhinoceros, whose remains are found in such abundance along with those of the mammoth (*Rh. tichorhinus*), had a woolly fleece interspersed with stronger bristles, manifestly as the result of adaptation to colder climates.

The skeleton of these animals everywhere shows heavy clumsy forms, with very marked ridges for the insertion of the muscles. The skull is in some species short and compact, in others greatly lengthened in consequence of the enormous size of the jaws. The rough warty patches indicating the place of attachment of the horns (which, in some species, may grow to a length of more than 3 feet) are very conspicuous on the back of the nasals. The transverse ridges at the back of the head, the processes of the vertebræ, the

ridges on the bones of the limbs, and especially the third trochanter on the thigh, are enormous; even the ribs have oblique middle ridges throughout their entire length.

The dentition is characterized by the want of constancy in the front teeth, and the peculiar form of the enamel folds in the cheek-teeth. The canines are always wanting, so that a considerable interval separates the cheek-teeth from the incisors, which were originally (in fossil forms) four or even six in number both above and below. The rhinoceroses of the present day have at first two incisors in each half of the jaw, but their subsequent development varies greatly. In the upper jaw the incisors are very close-set; the outer pair are the smaller and first disappear. In the lower jaw the incisors are conical, almost horizontal, and directed forwards; the outer ones are often very strong, and in some fossil species developed almost in the form of tusks. They persist the longest; while the inner ones drop out early, although always subsequently to the shedding of the outer incisors of the upper jaw. At last all the incisors disappear and are never replaced. We thus have species in which there are only two incisors above and four below; others in which only two incisors are found below in the adult; and others again in which they are latterly altogether wanting, and in which the callous margins of the gum serve to root up plants. In the young animal the various stages of this gradual reduction can be observed. The cheek-teeth are seven in number in each half of each jaw, in all twenty-eight, but they are very diverse in their nature. The upper ones are much larger than the lower. They have two irregular transverse prominences, which are separated on the inside by a deep winding fissure, but on the outside are connected by a longitudinal fold. When the tooth has been worn down to some extent these prominences seem to be surrounded by a continuous curiously-twisted strip of enamel. The lower cheek-teeth are longer than broad, and

exhibit two sickle-shaped bodies surrounded by enamel, these bodies standing obliquely behind one another and having their convexity behind.

Among the internal parts of the organization we may take note of the relatively small simple stomach, the enormous colon and cæcum, the small brain, the two-horned uterus, the two inguinal teats, and the diffuse placenta. The female remains pregnant seventeen months, and brings forth a single young one, which is defended by the mother with fury. The horn begins to grow only when the young animal has advanced a little in age; the new-born animal has only a slight swelling on the nose, such as characterized the hornless ancestors of our present rhinoceroses (*Aceratherium*) throughout life.

The habits of these dull, stupid, and clumsy but powerful animals are almost everywhere the same. They are exclusively herbivorous; but while most of them prefer marshy woods, the jungle, and the banks of rivers and ponds where they can wallow in the mud, we have African species (*Rh. simus*) which show a preference for the steppes with dry stiff grasses. But in general rhinoceroses require water and mud if it is for nothing else than to defend themselves against the insects which torment them in spite of the thickness of their hide. These giants have no enemy to fear except man. Lions and tigers go out of their way, for their horns and feet are terrible weapons, and when once a rhinoceros has broken out into fury nothing can withstand the violence of his onslaughts. With head down he darts upon his enemy, throws him to the ground, and tramples him under his feet. We have heard of battles between elephants and rhinoceroses, but no recent observer has ever witnessed one. But it appears that these two giants of the forest shun one another, although in Quaternary times the mammoth and the rhinoceros with bony nasal septum manifestly lived together as peaceable neighbours.



To face page 49.

PLATE XIX. -- THE INDIAN RHINOCEROS (*Rhinoceros indicus*).

The rhinoceroses have an acute sense of hearing and a keen scent. They avoid man when they have come to know his power, and in hunting these animals it is necessary to observe carefully the direction of the wind and to proceed without noise. But when met unexpectedly or driven into a corner the rhinoceros becomes terrible, and woe to the sportsman who misses his aim! In the forests which they inhabit they make paths for themselves through the densest underwood by treading down everything in their way, and although the hunters make use of these paths they nevertheless carefully avoid meeting with these stupid and passionate animals. In captivity the rhinoceroses are sluggish, unintelligent, and unsocial. They can scarcely be rendered attached to their keepers, who are obliged to behave with great caution towards them. They astonish but do not attract visitors.

The rhinoceroses may be divided into two groups.

The **Asiatic Rhinoceroses** have permanent incisors, and armour-plates on the hide separated by deep folds. They have sometimes one, sometimes two horns.

In a full-page illustration (Pl. XIX.) is shown a one-horned species known from time immemorial, the **Indian Rhinoceros** (*Rh. indicus*), which is distributed over the region from Bengal to Cochin-China. It attains a length of 13 and a height of 6½ feet. The horn, more than a foot and a half long, is curved backwards and is rather slender; the upper lip is very large. It has the most complete armour of all. One plate covers the back of the neck, another the shoulder, a third the belly, a fourth the rump, and a fifth the thigh. The hide is of a dirty-gray colour. Pompey caused the first specimen which was ever seen in Europe to be brought to Rome in the year 61 B.C. It is eagerly pursued on account of the tremendous ravages it commits in plantations. Among the other eastern species the **Javan Rhinoceros** (*Rh. javanicus*

(*sondaicus*)) is one-horned like the preceding species; while that of Sumatra (*Rh. sumatrensis*), and another from Malacca, with tufts of hair on the ears (*Rh. lasiotis*¹), have two horns and form the transition to the African species.

The **African Rhinoceroses** have all two horns and a thinner hide forming folds without plates. Their incisors drop out.

The **Two-horned Rhinoceros** (*Rh. bicornis*), Pl. XX., is quite as large as the Indian species, but the head is shorter and carries two horns, the foremost of which is the longest. The hide has a dark-brown colour inclining to black. The animal formerly inhabited the whole of the mainland of Africa down to the Cape, but has been driven northwards towards the interior by the colonists on account of the ravages it committed in their plantations. It is regarded as much more stupid and much wilder than the Indian species. The hide has only small folds.

[The Hon. W. H. Drummond, author of *The Large Game of South and South-east Africa*, speaks on several occasions of the ferocity of *Rh. bicornis*, which he considers the most dangerous of all African game. This ferocity, however, is exhibited only towards man, and without doubt there is good reason for its manifestation. "Their cunning," he writes, "is only equalled by their viciousness. In most, if not in all cases, they will at once charge on getting the wind of a human being, and if they cross his track they will often follow it up like a dog, making none of the puffing sounds natural to them when angry, till they absolutely see him. When wounded, and occasionally when much disturbed, their spoor consists of parallel straight lines, so that it is next to impossible to overtake them without being discovered, and giving them an opportunity of charging you from one side. They will wait with the utmost patience concealed in thick jungle, until you almost touch them, and then rush out at you. When they do catch an unfortunate being, they knock him down and knead him with their feet, returning again and again until nothing but a shapeless mass remains,

¹ This is a very rare animal. Only two examples are said to be as yet known. See *Nature*, vol. xxix, p. 427.—Tr.

uttering all the day their shrill squeal of rage. This I once saw myself.

"Four of us, consisting of myself, three native hunters, and my gun-bearer, were on our way to join a native hunting-party some twelve miles off, and just after crossing a small stream about half-way we saw a flock of rhinoceros-birds hovering over an ukaku thicket, and evidently accompanying some game passing through it. The place was of no great size, so two of the hunters ran round to the further sides, while I and the remaining one went into it, and in a few seconds struck the spoor of an upetyane.¹ I am thankful now to recollect that I at once suggested leaving the vicious brute alone, partly because it was such dangerous work and its death would do us no good, partly on account of the time it would waste and the distance we had yet to go. However, the hunter wanted to go after it, and to have said more would have implied fear on my part, a thing one has to guard against when, being the only white man among natives far in the interior, one's comfort, and not impossibly one's life, depends upon one's prestige; and so we went on, and in scarcely five minutes I saw it, having already heard it snorting like a steam-engine, trotting along, tossing its head, and looking like mischief personified, having evidently got the wind of some of us, and being quite as anxious to find us as we it. It was about fifteen yards off, and I instantly let drive with both barrels into its shoulder, springing as I did so into the tree under which I was.

"My unlucky companion, who was a little distance on one side, and had hitherto only heard it, came running towards the shots, and absolutely met it face to face; he at once fired and turned to run, but it was too late, and he was caught on the spot, thrown up with a single toss, which must probably have stunned him, and was then trampled out of all semblance to humanity by the bloodthirsty brute. Any description would be sickening. I could do nothing, for my gun-bearer had disappeared, seeking safety in some other spot, and I found that I had not a single cartridge left in the little pouch I carried; but after a minute I could stand the inaction no longer, and getting down from the tree unperceived I stole away, and as soon as I was out of reach began to shout to the others. Two of them soon came up, my gun-bearer and a hunter, one of them having hidden himself on finding the sort of animal we had to

deal with; and I having got a supply of cartridges, we went back to the spot until we got sight of the brute, still trampling and squealing, when, kneeling down, we fired at it together.

"My nerves had been so much shaken that I was unsteady and missed clean, not twenty yards off, but the ball from my companion's great elephant-gun sped more truly, and the brute fell on its knees, where, by dint of repeated if not very well-aimed shots, I succeeded in keeping it until he had reloaded, when we finished it off together."

In illustration of the ferocious disposition of the animal one instance is related in which the consequences are little more than amusing to read, though disagreeable enough no doubt at the time of the occurrence. A small party of hunters, of which Mr. Drummond was one, were engaged in roasting an antelope, the sole resource after a hard day's work, for their evening meal. "In about an hour the first shoulder was done, and the boy brought it to me and stuck it up in front of me by means of the stick which had already been supporting it while roasting, and I, drawing my hunting-knife, and sharpening a stick for a fork, was just in the act of breaking my fast for the first time that day, when I heard a sudden succession of puffs, like a train just starting, and could distinguish the heavy footfall of some animal. In a second everybody was on his feet, and in another we were all scrambling up the tree, I, I am sorry to say, still holding on to my shoulder of antelope, and oblivious of the fact that I had left my gun down below. We were barely in time; indeed, if the rhinoceros had charged straight up to the tree it must have caught me; but it was not necessary to go very high, and I was soon able to watch its movements. Hardly ten seconds had elapsed since I had heard the first warning puff, and now our fire was scattered in every direction, and the vicious animal was stamping upon it and everything else it saw, and squealing with rage the whole time. The meat had disappeared, some of it trampled into the ground, and some thrown yards away by its feet; two great burning logs of wood were smoking on the top of my spread-out bed, and even from where I was I could smell the smouldering blankets; the remains of my water-calabash were lying in every direction, and everything in camp, save my gun, which the brute had not so far touched, was more or less destroyed. It was enough to try any one's temper, and I asked the man next me if his gun was loaded, and

¹ Native (Kaffir) name of the *Rh. bicornis*.



To face page 48.

PLATE XX. — THE TWO-HORNED RHINOCEROS (*Rhinoceros bicornis*).

on getting an affirmative answer I told him to pass it over to me, and propping myself up against the trunk to prevent myself being knocked down, for it was an elephant-gun of six to the pound, I aimed at the shoulder of the trampling and squealing beast and pulled the trigger. A stillness followed the report for a second, and then a heavy thud, and after that violent struggles on the ground. The other hunter had a double-barrel, and emptied both of them into the struggling mass below him; but despite the shots the brute regained its legs, and went away the moment after it did so, its vicious temper much sobered by the treatment it had received. Ours were not, however, improved by the incident, and it was all I could do to prevent one of the hunters, who was almost speechless with rage at losing his supper, from giving chase on the spot. . . . A shoulder of antelope was not much among four famished men."]

Another African species (*Rh. simus*) is the largest of all. The head is very long, the snout rounded like that of an ox, the front horn very large, a yard and more in length, the hinder one very small. This species frequents the steppes covered with tall grass, amidst which it often grazes in very numerous herds, and in the dry seasons it undertakes great journeys in search of water. This species, notwithstanding its superior size, is regarded as the most good-natured of all. It is hunted chiefly for its flesh, which appears to be excellent.

THE HORSE FAMILY

(EQUIDA).

In our present fauna this family forms a group so well characterized by the structure of the feet, and so natural, that if only the living types are taken into consideration one is perfectly justified in making a separate order out of them under the name of *Solidungula*, the single-hoofed. But the distinctions, seemingly so sharply defined, gradually disappear when we place the forms that have lived in earlier times side by side with the living ones. The feet provided with a single hoof are then seen to be the last stage in a

process of evolution in course of which there first appeared forms which had feet like the rhinoceroses and tapirs, and in which the general characters of the *Perissodactyla* are revealed with so much clearness and distinctness that it is impossible to assign a greater value to the equine type than that of a family. The horse is the last member in a series of forms due to a process of specialization governed by the tendency to transform many-toed and comparatively sluggish, heavily-built animals into runners, which do not yield in fleetness to any other forms. The feet are simplified by this process to the highest degree, and are modified so as to be adapted solely for running. If we adopt the standpoint which it has been our constant aim to maintain in this work with respect to the evolution theory, we must regard the *Solidungula* as the type of a highly-specialized family.

We all know the general characters of the horses, zebras, and asses which make up this family. The greatly-elongated head with straight profile and sharp-pointed ears, the long neck, the relatively short body borne on long slender legs, the feet ending in rounded hoofs, the tail of moderate length bearing a long brush composed of coarse hair, the mane of bristly hair on the neck, the covering of finer short hair on the body lying very thick but so closely applied to the skin that the most minute details of the form are visible; all these characters are such as the reader does not need to be reminded of. The feet with only a single hoof enable us to recognize at the first glance the not very numerous species of this family which are now found wild only in the Old World. As domestic animals the horses have not only reconquered the domains which they formerly inhabited, but have spread over the entire surface of the earth save only the extreme Polar regions.

The skull of the horses when seen from above strikes us by its narrow greatly-elon-

gated rhomboidal form. The cranial region is relatively very small, forming only a little more than one-third of the whole length of the head, and it becomes greatly constricted near the *foramen magnum* or opening by which the spinal column passes into the brain. The brow is flattened and is continued almost horizontally into the long nasal bones, which form a beak-like roof above the nostrils. In front of these projects the elongated portion of the upper jaw which carries the incisors and canines. The pretty large orbits are surrounded by a complete bony ring, but leave a wide opening behind into the temporal fossæ. The halves of the lower jaw are completely fused in the middle, as in the tapirs, whose jaws have a great resemblance in their general features to those of the *Solidungula*.

The dentition of the horses also resembles that of the tapirs in the general arrangement. Both above and below we find a semicircle composed of six incisors in the form of somewhat curved chisels with blunt edges. The canines, which are in all cases but slightly developed, and which in the females for the most part disappear entirely, although more prominent in the males, are larger in the lower jaw than in the upper, and in that jaw follow close after the incisors, while in the upper they are rather farther apart from these. As in all other *Perissodactyla* a long interval divides the cheek-teeth from these front ones. It is in this interval that the bit is placed. The cheek-teeth, seven in number in each half of each jaw, are much larger in the upper jaw, where they present a quadrangular chewing surface, than in the lower, in which these teeth are more elongated and laterally compressed. The first of these cheek-teeth is always very poorly developed, reduced, in fact, to a mere stump; it is very readily and often very early lost. The other six cheek-teeth in the upper jaw appear as if composed of two halves, which are soldered together by a strong external vertical pillar. To this external pillar there corresponds on

the inner side another less prominent broad pillar, which shows on the grinding surface in the form of a loop of enamel. On the surface of each tooth are to be seen four sickle-shaped enamel stripes with their concavity directed outwards; and these stripes are separated from each other and in the middle by deep fissures. In the lower cheek-teeth the pillars are wanting. Each tooth has on the outside and in the middle a deep vertical groove, which indicates the separation into two halves, and the enamel stripes run back each into itself, as if there had been bosses or tubercles, the surface of which became planed away. This kind of dentition forms, as will be readily seen, an excellent masticatory mill.

The structure of the limbs deserves special attention. The bones corresponding to the upper arm and thigh are short, thick, and buried in the flesh of the body. The third trochanter on the thigh-bone is placed pretty low down. The ulna and fibula are greatly reduced, and are recognizable only as unshapely adjuncts at the upper part of the radius and tibia respectively. The bones of the wrist and ankle are greatly reduced both in number and size. These are followed below by a single bone, which is often erroneously spoken of as the shin-bone, but which is nothing else than the excessively developed metacarpal (or metatarsal) bone of the middle toe, and has at its upper end two small pointed style-like bones (the splint-bones) attached to it on both sides, these being the remains of the metacarpal (or metatarsal) bones of the second and fourth digits, which are thereby only indicated. Finally, at the lower end of this elongated metacarpal or metatarsal there come the three phalanges of the middle digit, which form the fetlock and hoof, the bone of which latter has pretty much the same form as the horny hoof that covers it. By studying the development it may be shown that in the embryo three digits begin to be formed, but that the two outer ones



To face page 50.

PLATE XXI. — THE DAUW OR BURCHELL'S ZEBRA (*Hippotigris Burchellii*).



remain rudimentary; and the examination of the feet of the ancestors of the horse reveals to us the fact that there were actually five toes in the first representatives of this group. Examples of foals born with two or three more or less developed toes are not rare.

We wish further to draw special attention to the smallness of the brain and its lowly organization, indicated by the fact that the hemispheres of the cerebrum do not cover the cerebellum. This lowly organization is, to be sure, in a certain measure compensated by the number of the convolutions, which in their disposition follow the same general plan as those of the tapirs, but are much more complicated. Between these two animals the relations in respect of brain-structure are somewhat similar to those which subsist between man and the macaque. The general plan is the same, but in the lower type it is shown in its original simplicity, while in the higher it is complicated by a thousand secondary formations. We likewise mention the structure of the digestive organs, which is in accordance with the plan exhibited in all herbivorous perissodactyles: a simple and relatively small stomach, a very thick colon and cæcum. The two teats are situated in the region of the groin.

The wild horses—for it is only these with which we have to do—live in great herds in prairie and steppe regions. That is their true home. For this social life in lands with a wide horizon they are wonderfully organized. Mountains they shun, and they seek the woods only to enjoy the shade for a brief interval. It must be allowed that neither the keenness of their senses nor their powers of defence are sufficient to adapt them for a life in the thickets, where each individual is compelled to have his qualities developed in the highest degree. The range of vision in horses is not very great; they can distinguish only near objects clearly. Their scent is dull. Only their hearing is very acute, and enables them to distinguish the least audible com-

ponents in distant noises. Observations on the development of the senses have been made chiefly, though not exclusively, on domesticated horses that have run wild. It has been established that in the pampas the mustang does not scent the jaguar at more than thirty paces off, and that the lion is always sure of getting within the necessary distance for a spring when a zebra is the object of his pursuit.

The herds live under the leadership of some old males, which have to watch over the well-being of their subjects. We cannot but admire the courage of these proud creatures, which, seeming to rejoice in battle, dart down upon an attacking carnivore, the whole herd arranging itself in a circle with the foals in the middle, and all ready to strike with the hoofs of their hind-legs. In fighting with wolves stallions try to seize their antagonist with their teeth by the nape of the neck, then to lift them up and dash them on the ground, after which they trample them underneath their feet.

But these battles, from which perhaps the military art has derived the formation of squares, are only exceptions to the rule, and take place only in cases of sudden attack or when the herds are driven to straits. Usually the herd seeks its safety in rapid flight. Tearing along in furious gallop, with ears and mane erect, the herd dashes away with the speed of the wind, driving their young ones before them, the males galloping on the flanks and at the end of the column to protect the herd in its hurried flight. No carnivore can follow them long. The Cape hunting-dogs alone can keep up the pursuit for several hours, and even then they are compelled to content themselves with the stragglers who have got wounded in the flight; they are not able to follow the herd, which at last disappears beyond the horizon of the immense plain.

The leading traits of wild horses are accordingly these: dull senses, little intelligence,

great sociability, and a courage amounting even to rashness.

Except for the battles between the fiery stallions, and especially the younger ones, in their efforts to secure rights for themselves as regards the mares, the herds live together in harmony. The old males chase the young

ones out of the herd when the latter begin to show an inclination for the mares, and these young ones, which are compelled to live as celibates, bring on serious battles with a view to acquire by conquest a few females with which to found a new family. The herds make great migrations in the steppes



Fig. 148.—The Zebra (*Hippotigris Zebra*).

and deserts in order to seek out good pastures or water.

Wild horses are keenly pursued for the sake of their skin and flesh, which is highly esteemed, and also in order to procure menagerie specimens. They are caught in winter in snares; but usually advantage is taken of their excessive curiosity, and of the passion which the males betray even for domesticated mares. The arts resorted to differ according to the locality and the character of the people; but they all come to this, that the hunter endeavours to introduce himself either on horseback or on foot into a herd in order to kill the adults and capture the foals.

The species are but slightly different from

one another in internal structure. The skeleton, the dentition, are so much alike, that apart from the size it is difficult to distinguish the species except when seen alive or stuffed, when the colour and markings of the coat, the length of the ears, &c., afford more or less well-defined characters.

The horse family may be divided into two groups, distinguished by the markings of the coat, and almost completely separated from one another in geographical range.

Most of the **African Horses** have a coat adorned with dark stripes on a light ground. They have been united into a subdivision under the name of *Hippotigris*, that is, **Tiger-horses**. They are in general well-proportioned,

have a small head, moderately large ears, and short straight mane. The middle line of the back is somewhat curved downwards as in the horse; the tail has little hair at the root, but ends in a long tuft; the hoofs are elegant, but exceptionally broad behind. A dark stripe always runs along the middle line of the back as far as the tail. The transverse dark stripes are differently distributed in the three known species, which all inhabit Africa south of the

Sahara. It has been observed that the herds of these beautiful and fleet animals live on a good understanding with certain antelopes, and still more with ostriches, and thus derive advantage from the watchfulness of these comrades. A few specimens have been tamed, but they mostly remain savage and intractable, much given to biting.

The Zebra (*Hippotigris Zebra* (*Equus Zebra*)), figure 148, frequents chiefly hilly

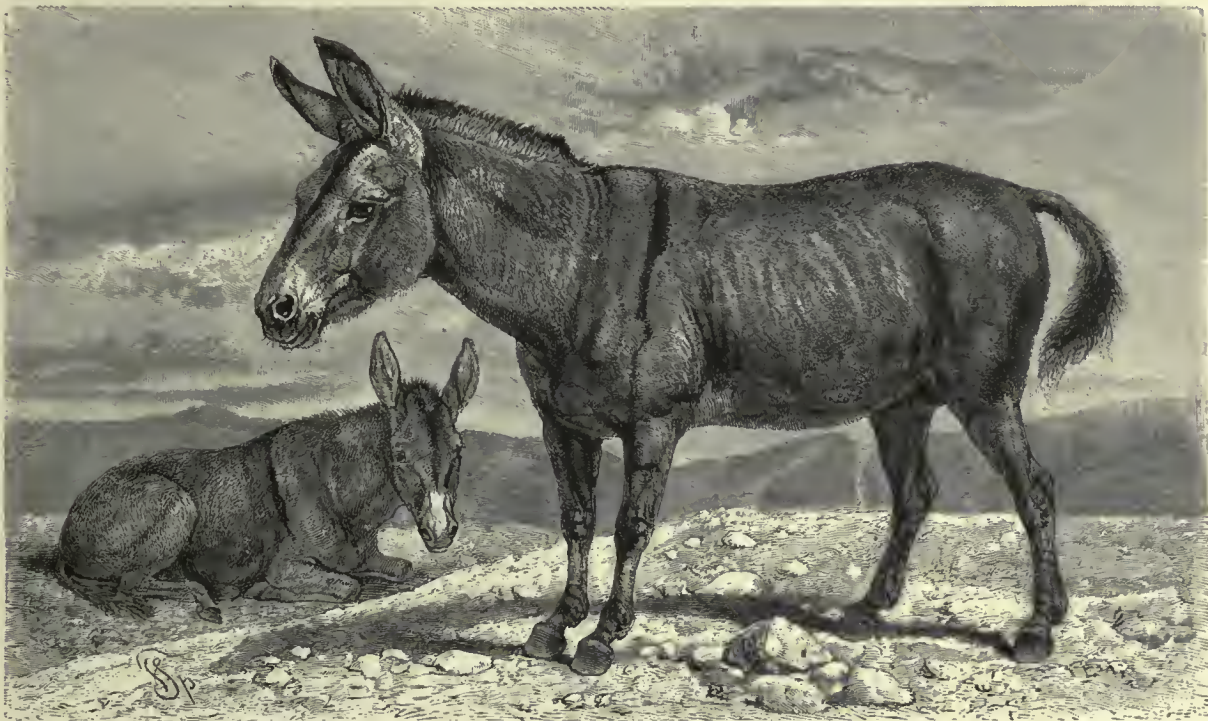


Fig. 149.—The African Wild Ass (*Equus taniopus*). page 54.

regions. It is entirely marked with black stripes on an almost white or yellowish ground. The legs are ringed down to the hoofs, and the mane is composed of alternate black and white stripes. The tail is black. It is the rarest species in our menageries. The Jardin d'Acclimatisation at Paris has a well-trained pair which draws a carriage.

The Daww (*Hippotigris* (*Equus*) *Burchellii*), Pl. XXI., is distinguished from the former species by having the legs and feet not ringed but of a uniform light colour like the ground colour of the body. The stripes on the body are broader, directed obliquely backwards, and forked at their lower ends. The head

presents pretty much the same mingling of colours as in the zebra.

A third species, the Quagga (*Hippotigris* (*Equus*) *quagga*) is brownish above, white underneath. The tail, which is completely covered with bushy hair, and the ears are white. The rather broad brown stripes attain a considerable length only on the neck and shoulders, gradually diminishing in length on the back. The whole of the hinder part of the body as well as the legs remain unstriped.

It is these two latter species that are generally seen in menageries. They are more easily tamed than the zebra, and it is said that in the South African colonies individuals caught young are associated with herds of

sheep, which they defend vigorously against the attacks of wild animals and especially hyænas.

The **Asiatic Horses** approach more nearly to the ass in the greater length of their ears, in the nature of the dark stripe along the back, in the greater thickness of the head, and in the more delicately-formed feet. Like the ass they have only a terminal tuft on the tail,

and frequently a dark vertical stripe on the shoulders, forming with the longitudinal stripe on the back the cross common on the domesticated ass. They are found on both sides of the Red Sea.

The **African Wild Ass** (*Equus tæniopus*), fig. 149, inhabits the districts east of the Nile to the shores of the Red Sea. It is probably one of the parent stocks of the domesticated



Fig. 150.—The Onager (*Equus onager*).

ass, and in particular that of Egypt. It is large and slender, of a pale-brownish or grayish-yellow colour, with a very marked cross, and some inconspicuous circular markings round the lower part of the legs immediately above the hoofs. The mane is long, the tail-tuft very long, the ears pretty long but elegantly formed and sharp. The domesticated ass of Abyssinia closely resembles this species, which, with its markings on the legs, forms the transition from the "tiger-horses" to the wild asses of Asia.

Among the two known species belonging to Asia the **Onager**, the **Gurkur** of the natives (*E. onager*), fig. 150, approaches most nearly to our domesticated ass. It inhabits the

steppes of Asia Minor, Arabia, and Persia, and extends as far as the frontiers of India. The head is clumsy, thick and short, the ears long, the mane soft, the tail-tuft pretty long. The general colour is grayish-white, passing over to a pale isabel-yellow. The brown cross is bordered with white, but is sometimes wanting.

The **Tibetan Wild Ass** (*E. hemionus*), fig. 151, stands midway between the horse and ass. The different names which the natives give to this species, distributed over the whole of the interior of Asia from the Kirghiz steppes to Tibet and China, have given rise to confusion. According to some of the more recent authorities, whose opinion we share,

the Kulan of the Kirghiz, the Jiggetai of the Mongols, and the Kiang of the Tibetans are one and the same species, comprising a few very slightly different geographical varieties. Besides the short and somewhat massive head the animal has the same very harmonious proportions, the same graceful outlines, slim legs, and thin hoofs. The ears are somewhat longer than those of the horse, but shorter than in the mule. The line of the back is straight, but slightly elevated at the croup; the tail is furnished with a long tuft; the mane is erect and pretty thick. The general colour is a light isabel-yellow. The belly



Fig. 151.—The Tibetan Wild Ass (*Equus hemionus*).

and inner sides of the legs are whitish yellow; the mane and tail dark brown. The dark line on the back sends no branches down the shoulders. Examples of this species are now to be seen in almost all menageries. Most of them come from the Jardin des Plantes at Paris, into which Dussumier introduced a few pairs, which propagate there. On several occasions some of these animals have been trained with pretty fair success. Numerous variations in colour have been observed.

We have now to face the question of the origin of the domesticated horse (*E. caballus*), which man has diffused over almost the whole surface of the earth. The problem is not less

complicated than that relating to the origin of the domestic dogs, and all the more difficult of solution since we know very few wild species that could be brought into relation with the domestic races.

With regard to the Ass (*E. asinus*) there are, perhaps, scarcely any differences of opinion. We may feel certain that the two species above-named, the onager and the African wild ass, have each contributed their contingent to the formation of the different races.

But with reference to the domesticated horse we can take into consideration only the kiang or Tibetan wild ass among living

species, together with the extinct species which have lived during Quaternary times. The tiger-horses of Africa cannot have contributed to the formation of the domestic breeds. Stripes and lines are too rare in these latter for us to be able to consider them as reversions to an original type of colouring.

One fact dominates the whole problem, at least so far as Europe is concerned. Throughout the Quaternary period the whole of our continent was inhabited by a race of small wild horses which were eagerly hunted in the Stone Age. Whole graveyards of these animals slaughtered for food have been found,



Fig. 152.—The Tarpan (*Equus Tarpan*).

for example, at Solutré, near Mâcon (Saône-et-Loire). While previously an object of eager pursuit this small animal was probably domesticated at the time when polished stone implements were used (the Neolithic Age), when agriculture was introduced. It is accordingly highly probable that the small horses of Norway, the Shetland ponies, and those of Corsica and Sardinia, are the more or less modified descendants of this prehistoric small and rather thick-headed horse.

But there were also horses of larger size during Quaternary times. As regards America this is incontestable. The horse with curved incisors (*E. curvidens*), which roamed over the whole of America during Quaternary

times, was of about the size of a pretty tall domesticated horse. But this American species has left no descendants. At the time of the discovery of America there were no horses in the New World.

The large domestic horse was probably introduced into Europe along with the use of metals. It came from some of the countries bordering on the Mediterranean, perhaps from India, where it had long been domesticated. But we do not know with certainty any Quaternary predecessor. Can the domestic horse be derived from the Tibetan wild ass? That is very doubtful.

If we turn our attention to the horses that have again become wild in the steppes of

Asia and America, we scarcely meet with any solution of the riddle.

An illustration is furnished of the degenerate horse of Asia, the *Tarpan* (*E. Tarpan*), fig. 152. These horses as well as the mustangs of America exhibit some common characters. The skin has acquired a uniform colour, dark-brown in summer, lighter in winter. The head is thick and short, the neck long and slim, the ears long and pointed, the hoofs delicately formed and narrow. The size has diminished, and the mane, which has become shorter, exhibits a decided tendency to become erect; but the tail is bushy throughout its whole length. We thus see that these degenerate horses have made a few steps backwards in the direction of the Tibetan wild ass; but yet the distance that separates the two appears to be still too great. It is possible that by careful selection, by giving an abundance of suitable food, and by constant attention, the domestic breeds have gradually been reared out of the Tibetan wild ass; but it is also possible that Quaternary horses, the remains of which may some time be found in Asia, have contributed to the production of our domestic breeds.¹

The domesticated horse has acquired its valuable qualities chiefly by association with man. Its courage must have been the quality

which man first learned to prize. Remote antiquity knew only how to employ the horse in war, in which it still shines. But whatever may be said, its intelligence is limited. What the horse is at the present day it owes to the training founded on its docility and curiosity.

[The behaviour of wild horses in Patagonia is graphically described in more than one passage by Lady Florence Dixie in her account of her journey across that part of the South American continent. "After a time," she writes in one place, "we came to a region evidently much frequented by wild horses, and eventually we hit on a path worn by them right through the woods, and following this, we jogged along at a very fair pace. Soon our horses began to neigh and prick up their ears as we advanced towards a clearing. Their cries were answered from somewhere beyond us, and pushing forward into the open we came upon a herd of wild horses, who, hearing our advance, had stopped grazing, and now they stood collected in a knot together, snorting and stamping, and staring at us in evident amazement. One of their number came boldly trotting out to meet us, and evidently with no pacific intentions; his wicked eye, and his white teeth, which he had bared fiercely, looked by no means reassuring. But suddenly he stopped short, looked at us for a moment, and then with a wild snort dashed madly away, followed by the whole herd. They disappeared like lightning over the brow of a deep ravine, to emerge again to our view after a couple of seconds, scampering like goats up

¹ A recent discovery of Przevalsky's has a great deal of interest in connection with the question of the origin of the domestic horse. That traveller has made the scientific world acquainted with a horse hitherto unknown inhabiting Central Asia, and possessing characters more closely approaching those of the domestic horse than any member of the genus hitherto discovered. The following paragraphs relating to it are taken from *Nature*, vol. xxx. p. 391 (where a cut of the new horse is given).

"The horses, which constitute the genera *Equus* of Linnæus, and are the sole recent representatives of the family Equidæ, fall naturally into two sub-genera, as was first shown by Gray in 1825 (*Zool. Jour.* i. p. 241)—*Equus* and *Asinus*.

"The typical horses (*Equus*) are distinguishable from the asses (*Asinus*) by the presence of warts upon the hind-legs as well as upon the fore-legs, by their broad rounded hoofs, and by their tails beginning to throw off long hairs from the base, instead of having these hairs confined, as a sort of pencil, to the extremity of the tail. Up to a recent period all the wild species of *Equus* known to science were referable to the second of these sections, that is, to the sub-genus *Asinus*, known from *Equus* by the absence of warts or callosities on the hind-legs, by the contracted hoofs, and by the long hairs of the tail being restricted to the extremity of that organ. . . .

"Under the circumstances great interest was manifested when it was known that Przevalsky, on his return from his third great journey into Central Asia, had brought back with him to St. Petersburg

an example of a new species of wild horse, which belonged, in some of its characters at least, to true *Equus*. . . .

"Przevalsky's wild horse has warts on its hind-legs as well as on its fore-legs, and has broad hoofs like the true horse. But the long hairs of the tail, instead of commencing at the base, do not begin until about half-way down the tail. In this respect *Equus przewalskii* is intermediate between the true horse and the asses. It also differs from typical *Equus* in having a short, erect mane, and in having no forelock, that is, no bunch of hairs in front of the mane falling down over the forehead. . . . Its whole general colour is of a whitish-gray, paler and whiter beneath, and reddish on the head. The legs are reddish to the knees, and thence blackish down to the hoofs. It is of small stature, but the legs are very thick and strong, and the head is large and heavy. The ears are smaller than those of the asses.

"Przevalsky's wild horse inhabits the great Dsungarian Desert between the Altai and Tianshan Mountains, where it is called by the Tartars 'Kertag,' and by the Mongols 'Statur.' It is met with in troops of from five to fifteen individuals, led by an old stallion. Apparently the rest of these troops consist of mares, which all belong to the single stallion. They are lively animals, very shy, and with highly-developed organs of sight, hearing, and smelling.

"They keep to the wildest part of the desert, and are very hard to approach. They seem to prefer especially the saline districts, and to be able to do long without water."—Tr.

its opposite side, which rose almost perpendicular to a height of six or seven hundred feet. They reached its crest at full gallop in the twinkling of an eye, and without pausing an instant disappeared again, leaving us wondering and amazed at their marvellous agility. I had often seen their paths leading up hill-sides which a man could scarcely climb; but till now that I had witnessed a specimen of their powers with my own eyes, I had scarcely believed them possessed of a nimbleness and cleverness of foot that would not discredit a chamois." —*Across Patagonia*, chap. xvii.]

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE ODD-TOED UNGULATES.

The present **Geographical Distribution** of the Perissodactyla would be altogether unintelligible if the relations to the extinct types did not shed some light upon the question, without, however, solving all difficulties. We must trace the stems of the different families back to their deepest roots, in order to obtain some fairly valid indications on the subject.

The **Rock-badger Family** (*Hyracida*) is an essentially African type, which, however, has advanced further east and has spread into Syria, Palestine, and Stony Arabia, where suitable conditions of life offered. Hitherto no direct fossil predecessors of this family have been found. But we must here take into consideration the fact that the soil of Africa is precisely that which has as yet been least examined with reference to palæontology. On the other hand, we know a pretty large number of fossil Perissodactyla derived from the upper Eocene and Miocene strata (*Lophiotherium*, *Tapirulus*, *Hyracodon*, &c.), which approach the Hyracida in size, in the general character of their dentition, and in particular in the structure of their teeth, and which therefore might well be their remote ancestors. The type would accordingly be one that had been very little modified since Eocene times.

In the case of the **Tapirs** it is altogether different. They occupy at the present day two widely-distinct centres in the tropics, the

larger in south America, the other in the Malay Peninsula and on the islands of Borneo and Sumatra; and what is very remarkable, the shabrack-tapir of the Sunda Islands is not so different from the Brazilian tapir as this is from the highly-interesting neighbouring mountain species of Colombia, out of which the genus *Elasmognathus* has been formed. We find the explanation of this striking phenomenon in the fact that during Eocene times the entire surface of the earth, with the exception of Australia, was inhabited by considerable numbers of tapir-like animals, which have indeed been continued down to present times, but have become steadily reduced in numbers while their domains have become more and more limited. These animals, which are distributed by palæontologists among numerous genera, were represented by different genera on the two sides of the ocean. The genus *Lophiodon* in Europe, those of *Hyrachyus* and *Helaletes* in America, were the ancestors of genera which already, in the Miocene of Europe, approached very near to the true tapirs, while this approximation in America did not become very marked till the close of the Tertiary period. On the other hand, their domain on the mainland of the Old World became contracted much earlier than on the New. Tapirs still existed in Quaternary times in North America, and it was only in the present geological period that they became confined to South America. I would insist especially on the great difference between the original American and Oriental stocks. These two stocks approach one another by a gradual process of development, each for itself and independently of the other, producing at last two species so closely resembling one another as the Malayan tapir and the Brazilian anta, which are so widely separated from each other in space.

The other two families of Perissodactyla now living, the rhinoceroses and the horses, agree in being now entirely restricted to the Old World, while they are both represented,

and that in quite respectable numbers, among the fossil remains of the New.

Let us speak first of the **Rhinoceroses**. At the present day we have about eight or nine species, half of which inhabit tropical Africa, while the other half are confined to India and the Sunda Islands. All the African rhinoceroses have two horns; in Asia there are both one-horned and two-horned species. All these species approach one another so closely that they can hardly be grouped with propriety into sub-genera.

The distribution during the Quaternary period was quite different from the present. Rhinoceroses were then found everywhere; in the extreme north as well as in the tropics, on the highest mountains (16,000 feet above sea-level in Tibet) as well as on low-lying plains, in the Old as well as in the New World. We know about twenty species from Quaternary, Pliocene, and Miocene strata, and we can trace their descent backwards to the time of the Upper Eocene. Step by step we can demonstrate the gradual modifications by which the old rhinoceroses have arrived at their present forms. The old types (*Aceratherium*) had no horns, and the development of the horns, which have mostly got separated from the fossil skulls, can be traced on the nasal bones, which at last come to be strengthened by a bony partition, to enable them to carry the enormous outgrowths by which they are surmounted. But in this case also we can follow out in the two hemispheres two different independent lines, derived from different stocks, which gradually approach nearer to one another, and which in Europe pass from the *Palæotheria* through the hornless forms (*Aceratherium*) to the true rhinoceroses; while in America the original genera are called *Coloniceras*, *Diceratherium*, and *Amycodon*, and are totally different from the European stem-forms. But in America there were only hornless forms, which die out with the Pliocene; while in the Old World the type is continued down to the present time, though

getting gradually more restricted in the area of its domain, which in Quaternary times was far more extensive. A rhinoceros with enormous horns and a bony nasal septum (*Rh. tichorhinus*) was the faithful companion of the mammoth, and, like this elephant, had a thick fleece as a protection against the severe cold of the Polar Regions.

The **Wild Horses** finally have a pretty simple distribution in the present-day fauna. The "tiger-horses" are inhabitants of tropical and sub-tropical Africa. The asses with a coat of uniform colour hail from the steppes and deserts of Asia, and the wild ass distributed over the western shores of the Red Sea forms the connecting link. But in this family we see astonishing circumstances in relation to the origin.

One of the most beautiful discoveries of the palæontology of the present day is that of the two parallel lines in which the horse type has gradually developed in the Old and the New World. In the latter have been found small five-toed animals of the size of a fox (*Eohippus Phenacodus*) in strata belonging to the Lower Eocene, and from this all the different stages up to the Quaternary horse (*Equus curvidens*) have been discovered without the omission of one. Every geological series of strata has revealed a separate genus different from that of the preceding group, and these successive genera approach the modern horse step by step through the increase in the size of the body, through the multiplication and increasing development and complexity of the enamel folds in the cheek-teeth, and through the gradual reduction in the number and size of the toes. In the Lower Eocene genera the tendency towards a reduction in the five toes present is already manifest. The middle toe is the longest and strongest; the second and fourth digits are equal in length, and though somewhat shorter than the middle one, still furnished with broad hoofs, which, without doubt, touched the ground. The fifth digit is much

smaller, has the last phalanx pointed, and, there can be no doubt, both it and the first digit, or pollex, which is quite rudimentary, bore a false claw, which could touch the earth only on sinking into soft or marshy ground. Henceforth the first digit disappears entirely. In *Orohippus* from the Middle and Upper Eocene the fifth still carries a false claw, but in *Mesohippus* from the Lower, and *Miohippus* from the Upper Miocene, is already reduced to the metacarpal (or metatarsal) bone, having no phalanges, while the second and fourth digits have become smaller. In *Protophippus* from the Lower Pliocene, as well as in the succeeding genera, the metacarpal bone of the fifth digit has also vanished, and the second and fourth digits no longer carry hoofs but claws. Then these two digits likewise get reduced to their metacarpal bones in *Pliohippus* belonging to the Upper Pliocene. The last member of this long series of genera forming successive links in an unbroken chain was a horse which was similar to the domesticated horse, but possessed rather differently formed incisors, and which, during the Quaternary period, roamed over the whole of America, both North and South, so that it has left remains in the deposits of the Pampas, as well as in the caves of Brazil and the alluvium of the United States.

In the Old World we have a similar though a less complete series. Our horses appear to be traceable back to the *Palæotherium* as their stem-form, this being an equivocal intermediate type with four toes on the fore-feet, and apparently also the stem from which the rhinoceroses have been derived. But in the genus *Anchitherium* of the Upper Eocene and the Lower Miocene the equine characters are already expressed with the utmost distinctness in the dentition as well as in the structure of the feet, and may be traced through the genus *Hipparion*, corresponding, we may say, to the American *Protophippus*, a genus which had three toes, and whose

numerous remains, found in Upper Miocene deposits at Pikermi in Greece and Sansans at the foot of the Pyrenees, prove that these elegant animals then traversed southern Europe in numerous herds.

I cannot enter into details here, but will only state that none of the genera belonging to the series in the evolution of the American horses is identical with any one of those belonging to the succession on this side of the ocean, and that the initial differences are greater than those at the end of the two series. The difference between the *Anchitherium* of the Lower Miocene of Europe and the *Mesohippus* on the same horizon in America is considerable, while the differences between the Quaternary horses of the two hemispheres are but slight. The series have accordingly approached one another instead of presenting increasing divergencies. But in both series is seen the same tendency to form out of small, plump, plantigrade or semi-plantigrade animals, omnivorous in their diet, and probably dwellers in marshy districts, larger, slimmer, light-footed herbivora inhabiting dry steppes.

To sum up, we see in the *Perissodactyla* a great original and old order which has gradually declined in the process of geological evolution. The stems to which we can now with greater or less probability refer the branches of our present fauna were much more varied, much richer in forms than they are now. There has been a gradual decay along with a one-sided development. By domestication the highly specialized type of the horses has reconquered the domain which it had lost at the beginning of the present geological epoch; the other types, not capable of domestication, seem to be surely advancing towards extinction, in which several pretty rare types have preceded them, types which have gradually died out in the course of evolution, and of which we do not need to speak here.

EVEN-TOED UNGULATES

(ARTIODACTYLA).

Ungulates of very variable size, almost always with an even number of toes, which are arranged about two parallel axes running through the middle line of the second and fourth digits. The thigh-bone has no third trochanter. The stomach shows a tendency to subdivision. The originally complete dentition gets gradually specialized and reduced. The teats are abdominal and inguinal. Placenta diffuse.



This order, now the most numerous after the Rodents, presents similar phenomena to those which we have observed in the previous one. In it, if we consider only the members now living, we in fact recognize two pretty different series of forms, which would necessitate a division into two orders, the ruminants on the one hand, and the pigs or many-toed ungulates on the other; but when we enter into the details of the organization, and especially also into those of fossil forms, then we must acknowledge that the lines of demarcation fall away one after the other, and that even among the living forms these limits are not so complete as those which separate the tapirs and rhinoceroses from the horses. Among the palæontological remains we find proofs of an evolution similar to that which we have traced in the perissodactyles. Out of the originally clumsy and heavy forms with a complete dentition and at least four toes touching the earth have at last arisen slender, shapely forms with elegant limbs, in which the toes are reduced to two and the dentition is no longer complete. The many-toed forms with complete dentition of our present fauna approach more closely to the ancestral stem-forms, from which have sprung, as palæontology proves, the two-toed forms

with incomplete dentition, those, namely, which have been called the Ruminants, on account of a special function, while the others may be called the Many-toed (Polydactyla).

The predominant character of the Artiodactyla is that which is presented by the structure of the feet, which always have the toes clothed with hoofs, and which are adapted only for locomotion. All these animals "divide the hoof," as the Bible says; in other words, the toes are arranged in pairs, and there are two equivalent widely separate axes formed by the third and fourth digits. The first or innermost digit is wanting even in the ancestral forms, which have four almost equal toes, with the corresponding metacarpal and metatarsal bones quite separate; while both bones of the lower fore-limb and hind-limb, that is, the radius and ulna in the one case, and the tibia and fibula in the other case, are likewise separate and attain an equal degree of development. This structure of the limbs has been preserved in the hippopotamus. The two lateral digits, the second and the fourth, then get steadily reduced in size in the general evolution of the group. The two middle toes alone touch the ground; the two lateral ones are shorter, but still carry false or accessory hoofs; the two middle toes

have their metacarpal or metatarsal bones still separable; and the bones of the limbs, radius and ulna in the fore-limb, tibia and fibula in the hind-limb, still persist as distinct bones. This structure is that seen in the pigs. Everyone knows that a pig's foot may be split along its whole length to the wrist or ankle. The reduction in the toes advances still further in the peccaries, that peculiar family of American pigs. In one species the inner toe of the hind-foot has vanished, so that this foot is only three-toed, and the metatarsal bones of the middle toes begin to get fused at their upper ends. Step by step we can follow in the same manner the reduction of the radius and fibula, that of the two lateral toes, and the fusion of the principal metacarpal and metatarsal bones, in the fossil forms as well as in those now living. A genus of living musk-yielding animals, *Hyæmoschus*, which has also been found fossil, still presents astonishing similarities to the peccaries in the structure of its limbs. The ulna, which in the other ruminants is reduced to a rudiment, still exists entire and quite separate from the radius. The metacarpal bones are not fused, while in the hind-limbs the tibia and fibula are completely fused and the metatarsal bones united at their lower end. The fusion goes on in such a manner that in the other ruminants, as in the horses, there comes to be only a single metacarpal or metatarsal bone, which, however, is distinguished from that of the *Solidungula* by always having more or less well-marked longitudinal grooves running down the middle line both before and behind, indicating the place of fusion of bones which are still separate in the embryo. This bone carries only the two middle toes, and at its lower end shows two rounded joint-surfaces corresponding to them. The two side toes gradually disappear, but are still represented externally by prominences and so-called false or accessory hoofs, and are recognizable in the skeleton by small style-like bones. Finally, in the

giraffe the limbs have reached the last stage of simplification: there is neither ulna nor fibula; the metacarpals and metatarsals are simple, without any visible groove or any trace of lateral toes. It will be seen that the process of simplification in this case is similar to that which we observed in the *Perissodactyla*, with only this difference, that in these there was only a single dominant toe, while in the *Artiodactyla* the changes all took place in relation to two toes of equal importance.

We do not intend to enter into details regarding the modifications which the different bones of the limbs undergo, but must, nevertheless, remark that the astragalus, the bone which is so characteristic in the ankle of the hind-foot, has a very different form from that which it presents in the *Perissodactyla*, so that we can say at the first glance whether this bone belongs to a member of the one order or the other.

The dentition likewise presents remarkable transitional series. Originally all these animals had forty-four teeth in all, three incisors, one canine, and seven cheek-teeth in each half of the jaw, and this number has only got reduced at a comparatively late period; for even in the ruminants, which have neither upper incisors nor canines, there are found in the embryos the germs of these teeth, which never get developed. In an Eocene artiodactyle, the *Anoplotherium*, we even find all the teeth in continuous close-set rows of equal height, as in man. The cheek-teeth are always complex in structure; composed of eminences or wrinkled and folded tubercles as in our present pigs, forming the type of the *Bunodontia*, or, as in our ruminants, of half-moon-shaped enamel folds, forming the type of the *Selenodontia*. Now the specialization of the teeth goes on hand in hand both with their reduction in number and with the change in the habits of the animals from an omnivorous to a purely vegetable diet, which change again is connected with the conversion of sturdy thickset forms into slender ones and with the loss or

transposition of the weapons of attack and defence. The incisors, which stand vertically in the upper jaw but are almost horizontal in the lower, gradually disappear altogether in the former. While the pigs have in all six incisors in the upper jaw, the hippopotamuses have only four, the camels only two, and in all other ruminants they are altogether absent. On the other hand, the lower incisors in the latter are increased by a pair, so that their total number is brought up to eight. It is probable indeed that the outermost pair consist of canines which have got displaced forwards. The canines, which in the hippopotamuses, pigs, musk-deer, and chevrotains are formidable weapons, always more highly developed in the male than in the female, are reduced in size in the camels and most of the deer family, and disappear entirely in the other ruminants. It cannot, however, be said that the growth of horns is an equivalent for the loss of the canines, for the muntjac has both horns and large canines, which are used by it as weapons. The number of the cheek-teeth, which are separated by an interval from the front-teeth, and can often be distinguished by their external form as molars and premolars, diminishes through the loss of the latter. The last molar exhibits a manifest tendency to increase in size, and this tendency is so marked in the wart-hogs that the masticating surface in them belongs wholly to this single enormously enlarged molar.

There is little to say regarding the internal organization. The brain and the skull are always very small in relation to the size of the body and the development of the elongated jaws. The brain itself exhibits a peculiar system of convolutions, which, in the smaller forms, are more simple, in the larger more complex. The cerebral hemispheres never cover the cerebellum, and they even leave a portion of the mid-brain exposed. Moreover, the Artiodactyla in general stand upon a very low level of intelligence, which, how-

ever, does not prevent them from having a certain keenness of sense.

Among the anatomical features we would draw attention also to the tendency of the stomach to become subdivided, a tendency which goes hand in hand with the change from a miscellaneous to a purely vegetable diet. In the Perissodactyla this change of habits affected chiefly the colon and cæcum. Most of the pigs still have a simple stomach. In the hippopotamuses and peccaries that portion of the stomach into which the œsophagus or gullet opens, the so-called cardiac end, is divided into two, making three parts in all. This threefold division is maintained likewise in the chevrotains; but in the other ruminants the other end of the stomach, the pyloric end, is also divided into two parts, so that the stomach now consists of four different sacs, which have four distinct functions.

Only in the pigs are the teats found extending in pairs along the whole length of the abdomen. In the other Artiodactyla they are situated in the region of the groin (placed inguinally). The placenta is always diffuse, spread over the whole surface of the ovum; but while in the pigs, camels, and chevrotains the placenta has still preserved a primitive character, being composed of delicate isolated tufts, these form in the other ruminants more compact masses, which have been called cotyledons.

Almost all Artiodactyla live socially, often in numberless herds, which, however, are without that more or less intelligent organization observable in troops of horses or societies of monkeys. Some rely for their safety on their strength, others on their speed. Although these animals are mostly stupid and unintelligent, yet certain of their senses, as smelling and hearing, may be extraordinarily keen and delicate. They can scarcely be said to show any attachment to man, who, nevertheless, has domesticated a great number of them. In all, without exception, even in the most peaceably disposed,

we can observe a liability to sudden accesses of fury, the causes of which it is difficult to guess, though they may be so violent as to lead the animals affected thereby to dash blindly against everything that stands in their way. Yet among all the orders of the Mammalia this is probably the one that is most useful to man, who derives the greatest advantage from it in respect of clothing, food, and labour. If in civilized countries it is impossible to dispense with the hollow-horned animals, such as the ox, sheep, and goat, which yield us their wool, milk, and flesh, and are in part an important aid in field

labour, the steppes and the deserts would be impassable without camels, and the existence of the Polynesian and Malayan races would be endangered if they were deprived of pigs, as that of the Polar races would be impossible without the reindeer.

We adopt two subordinate groups or sub-orders: the **Non-ruminant many-toed forms** (Polydactyla), which comprise the hippopotamuses and the pigs, constituting one; and the **Ruminants** (Bidactyla), to which belong the musk-deer, the true deer, the hollow-horned animals, the giraffe, and camels constituting the other.

GROUP OF THE NON-RUMINANT OR MANY-TOED ARTIODACTYLA (POLYDACTYLA).

THE HIPPOPOTAMUS OR RIVER-HORSE FAMILY (OBESA).

The **River-horses** (Hippopotamus) rival and even, if possible, surpass the rhinoceroses in ugliness. They form a specially African type, which consists of only two species, the smaller of which (*H. liberiensis*), almost a dwarf form, hitherto found only in the republic of Liberia, is but little known. This dwarf species, which has many affinities to a fossil form found in Europe (*H. minor*), attains only the size of a tapir, while the well-known species kept in our zoological gardens, the **Common Hippopotamus** (*H. amphibius*), which inhabits the whole of Central Africa, and even extends to the Cape, and which is figured in a full-page illustration (Pl. XXII.), attains a length of about 15 feet and a weight of about 2½ tons.

It is with good reason that the river-horses have been taken as the type of a separate family under the name of Obesa, the stout animals. Everything about them is heavy and large. The enormous belly almost drags on the ground; the feet are short, massive, somewhat twisted, and have four rounded hoofs on the short toes, which are connected together by an insignificant swimming membrane; the neck is short and thick, the head massive, long, and almost level on the surface, the tail short and furnished with a few thick bristles arranged in the form of a tuft. The hide, at least three-fourths of an inch in thickness, forms great folds on the shoulders and thighs, and is quite naked except for a few thinly scattered hairs in the folds. It is of a dirty copper colour. There is no other mammal which creates such an impression of a formless mass of revolting nakedness as the hippopotamus does.

The enormous head has the form of an



To face page 64.

PLATE XXII. — THE HIPPOPOTAMUS (*Hippopotamus amphibius*).

elongated rectangle, somewhat contracted below the eyes and rounded off in front with a thick snout, on which the nostrils open in the form of S-shaped slits. The eyes are small and surrounded by a projecting orbit. The ears stand at the angles of the back part of the head, where it sinks abruptly down towards the neck, and are small and in the form of pointed paper-cornets. When the animal is in the water, its true element, it so to speak drives this unshapely head along the surface in such a manner that only the ears, eyes, and nostrils are visible above the water, which forms a small pool on the depressed part between the eyes and nostrils. The latter open in breathing with a great noise and can be hermetically closed in diving. Only when the creature leaves the water can we see the muzzle, on which the upper lip is puffed up at the sides so as to conceal the tusks, and this gives a peculiar curved form to the opening of the mouth.

The skull of the animal is elongated in consequence of the enormous size of the jaws, while the brain-case is very small. The dentition is terrible. In the upper jaw there are two incisors, one on each side, set in the two halves of the premaxilla, which are separated by a wide excavation in the middle. These incisors resemble short pegs, and are kept sharp by use. The canines which follow these incisors form two lateral projections, and, like the incisors, keep growing without interruption throughout life. Their crown is very short, but is kept sharp by use. In the lower jaws both incisors and canines likewise keep constantly growing. The inner incisors are enormously long and straight, and directed obliquely forwards and upwards. In a young hippopotamus, whose last molars had not yet cut the gum, these teeth were more than a foot in length and about an inch and a half in thickness. The outer pair of lower incisors are smaller, but also of cylindrical form. The lower canines are of enormous size, and curved upwards, grooved on

their enamelled surface and worn away on their inner face so as to present a sharp cutting edge at the end. A pretty wide interval separates the cheek- and front-teeth in both jaws. In each half of each jaw there are seven cheek-teeth in all—four premolars with a conical elevation in the middle, and three true molars, which, before they are much worn, exhibit four folded conical tubercles separated by two deep fissures forming a cross. Through the effect of use the crowns come to present to view in place of the tubercles four figures like clover-leaves surrounded by stripes of enamel. This figure is characteristic of the teeth of adult hippopotamuses.

The "behemoth" of the Bible is an essentially herbivorous and aquatic animal. Formerly extending from the mouths of the Nile to the rivers of the Cape, it has now been pushed back into the interior by the advance of civilization, and in proportion as the rifle shooting heavy bullets with great power of penetration advances up the rivers and lakes of Central Africa will this huge animal gradually disappear. The natives hunt it successfully by hurling against it harpoons attached to floats, and then killing it with lances after terrible battles. But these are always only isolated encounters which cannot seriously diminish the numbers of the herds.

The hippopotamus is on the whole a nocturnal animal, and where it has made acquaintance with firearms leaves the water only by night, or if by day, only to bask in the sun on sand-banks and islands out of range of bullets. In the rivers and lakes whose banks are occupied by tasty plants rich in starch, such as it can easily uproot by means of its incisors and canines, it remains constantly in the water while seeking its food; but, on the other hand, where the banks are naked it quits the water in order to browse in the neighbouring woods and plantations, which it devastates in a piteous manner. Besides the fact of its having tolerably palatable flesh,

a hide yielding a good thick leather, and tusks affording an ivory as highly esteemed as that derived from the elephant, it is chiefly these devastations that have always drawn down upon it the furious persecution of the colonists.

It is a peaceable animal, a capital swimmer and diver, able to remain five minutes under the water without coming up to breathe, and fond of roaming about on dry land in the evening, when it will sport with other members of its own species, bellowing with joy in a voice which, according to the negroes, is equal to that of a hundred oxen. It spends the day in inactivity, and then affords an opportunity to insect-eating birds to wander about on its back hunting out the numerous parasites by which it is infested. It is said that these birds also serve as sentinels to the hippopotamus, giving it warning by their cries of the approach of danger. The only danger to which the hippopotamus is exposed is that which is due to man; other animals take good care not to attack this Titan. The stories told of battles between hippopotamuses, lions, and crocodiles are mere fables. The females of the species are tenderly attached to their young, which follow them about in the water a few hours after birth, and often sit riding on their back.

When wounded or pursued, or when from any cause it falls into a fury, the hippopotamus becomes terrible. It attacks boats, which it shatters between its formidable jaws, crushes men to death with its teeth, or tramples them with its paws, and sometimes it will dart upon its opponent from some place of concealment with the rapidity of lightning, overturning every obstacle by its mere momentum. The mothers appear to take revenge for their slaughtered and captured young even a considerable time after these have been lost. The narratives of travellers and natives are full of exciting accounts of hunts after and battles with these terrible beasts, which are all the more dangerous since even the heaviest

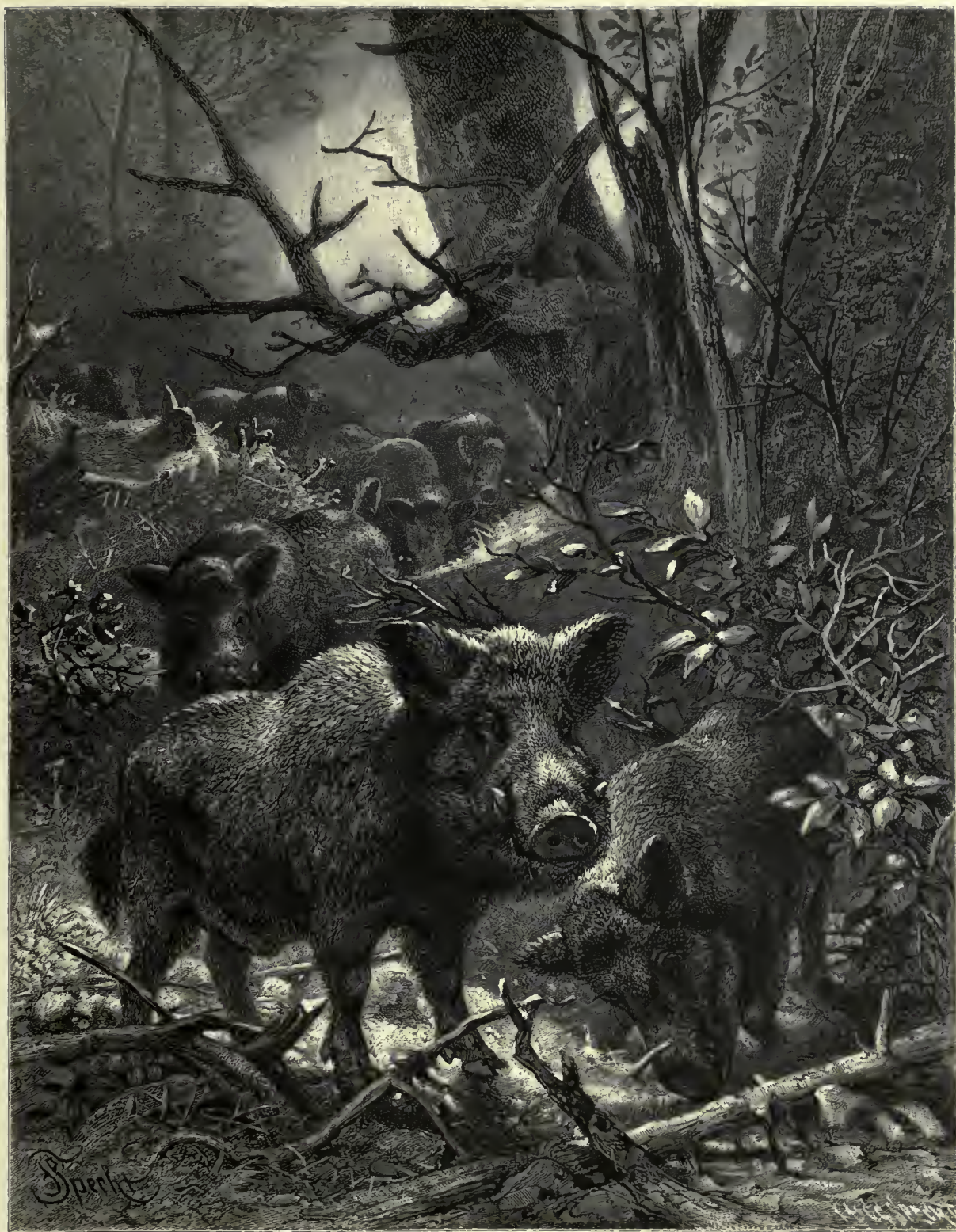
bullets can pierce their hide only at short distances, and the animal is remarkably tenacious of life.

Even the ancient Romans brought hippopotamuses to Europe for their games in the circus. In our time some specimens are to be seen in all zoological gardens, where they have even multiplied. Their intelligence is certainly very obtuse, and their keepers must always be on their guard; and so likewise must the spectators—for the hippopotamus has the habit of ejecting its semi-fluid excrement out of the water to a distance of perhaps twenty yards, this process being accompanied by jerking movements of the tail.

THE PIG FAMILY

(SUIDA).

The pigs or hogs form a separate family, characterized for the most part by having the upper canines almost always directed upwards, while the lower canines are so closely applied to them that the two together on each side form only a single tusk. With the exception of the peccaries, which have the upper canines directed downwards in the normal manner, the pigs do not defend themselves by biting, but make thrusts to the right and left and from beneath upwards with these laterally projecting weapons. The muzzle is drawn out in the form of a proboscis, and spread out at the end into a disc in which the nostrils open. With this very tough instrument, which is supported internally by the cartilage of the nose, the animal digs up the earth. The incisors are three in number in each half of each jaw, but the upper ones are very apt to be lost, and not infrequently do not cut the gum at all. The cheek-teeth are composed of numerous tubercles arranged in folds. The eyes are small, the ears always erect, pointed, paper-cornet-shaped; only in the domestic forms do they become broad and pendent. The hide is covered with stiff bristles, which often become lengthened to



To face page 60.

PLATE XXIII. — THE WILD BOAR (*Sus scrofa*).



form a sort of mane. The legs are thin in the lower parts; only the two middle digits touch the ground, and these are completely encased by hoofs; the lateral digits are short and carry accessory hoofs. The tail is rather short, sometimes even quite undeveloped; when present it carries a tuft of long bristles. The teats are numerous, and are situated on the abdomen. In most cases the young have a striped or spotted coat.

All members of the family are social and nocturnal in their habits, omnivorous in their diet, given to frequenting waters and marshes, and fond of wallowing in mire. They live in more or less numerous troops, and feed on all that they find. Though they consume principally plants, roots, and tubers, they have no hesitation in devouring the living animals that fall in their way, and do not leave even carrion untouched. Notwithstanding their voracity, their frequently disgusting food, and their habits, it cannot be said that they are in themselves filthy animals. They dig with their snouts in the ground, wallow in mire, rub themselves against trees to coat their bristles with resin, but they always choose out a particular place far from their lair in which to deposit their dung. By day they remain inactive, and they go about in search of their food by night. The banks of rivers and pools, bogs and marshes are their favourite resorts. They run and gallop tolerably well, uttering loud grunts, are excellent swimmers, and are assisted in this mode of locomotion by a thick layer of fat developed between the skin and the muscles. Their sense of smell is very acute. They follow the track of a wounded animal like dogs, and manage to find out underground fungi and tubers by means of their nose. Their hearing is likewise very keen, but the other senses are obtuse.

Usually peaceable, but by no means timid animals, the pigs know how to defend themselves both against beasts of prey and against man, when they find that they cannot escape

by flight. They support one another in their battles; the males, which are always better armed, defend the females and young with courage, and though not always victorious they are antagonists not to be despised.

The genera which we distinguish in this family are distributed over both hemispheres; but the pigs of the Old World are altogether different from those of America. We will begin with the former.

The true Pigs, forming the genus *Sus*, have preserved more of the original characters than the other members of the family, and if one will speak of antediluvian animals it is rather the pigs than the much more recent hippopotamuses, as is usually the case, that should be so designated.

In Pl. XXIII. is represented a family of wild-boars (*Sus scrofa*) belonging to our own division of the globe. This species has a very remarkable geographical distribution. It is found in all Asia and Europe, including the islands of the Mediterranean and the countries round, and extends even to the neighbourhood of the Arctic zone. A species so widely distributed could not fail to exhibit local varieties or races, which may present considerable differences among one another. It is, therefore, not to be wondered at when we find that each of the Sunda Islands has its own race, which has been described by many naturalists as a separate species, or that the wild pigs of the Atlas are a little different from those of Central Europe, which latter again can be very easily distinguished from their Indian kindred. The difficulties arising from this production of local varieties are multiplied by the facility with which all these races can be habituated to a certain kind of domestication, though just as ready to revert with equal rapidity to the wild condition when opportunity offers. Now, since the wild-boar has been domesticated from the earliest times in Egypt as well as in the East, there arises therefrom an extraordinarily intricate problem, since the naturalist always has to

meet the question whether he has to do with a reversion to the wild state, or an adaptation to the conditions of more or less complete domestication.

Be that as it may, our wild-boar has its head in the form of an elongated pyramid, with a flat brow and thick proboscis, behind which project the strong sharp tusks. The ears are small, erect, the legs pretty short but elegantly shaped, the tail curled and adorned with a long terminal tuft. The body is thinly covered with black bristles with yellow points, and these stand up as a mane on the back of the neck. The general colour is dark gray since the surface of the skin is black.

The dentition shows in the upper jaw six sharp incisors, close set in a long curved line on the edge of the very narrow premaxilla, two massive canines grooved on the outside and directed outwards and upwards, and seven close-set cheek-teeth. The first premolar is very small and laterally compressed; the three next in order gradually increase in size till we come to the true molars, the last of which is as long as the two immediately in front taken together. The crowns of the cheek-teeth consist of tubercles with numerous folds and furrows, and those of the lower jaw also are similar in structure. In this jaw, however, the six sharp incisors are placed horizontally and directed forwards, while the strong and long canines, which are triangular in section, are curved like a bow, and exhibit behind a polished surface resulting from friction against the upper canine. The first very small but sharp premolar stands pretty close behind the canine, and is separated by a considerable interval from the other teeth, which form a continuous series.

Fortunately for agriculture wild-boars are almost entirely extirpated in civilized countries. Among us¹ they are still kept in closed parks for the sake of the pleasures of the chase—a chase no longer dangerous. They still live in perfect freedom after the manner

of all pigs in a few large forests and in uncultivated districts. Formerly they were hunted with packs of strong and well-knit dogs, against which they show an instinctive hatred. When after a bloody battle, in which several dogs were usually ripped open, the wild-boar was driven into a corner, it received its death-blow from a particular kind of lance or spear (whence this form of sport is known as "pig-sticking"), or from the hunting-knife, which the hunter rested against his knee. The wild-boar would charge the huntsman, who was then placed in great danger if he did not succeed in transfixing the animal with his weapon. At the present day platforms are erected on which the hunters can stand in safety while the game is driven past them. Boar-hunting has come to signify shooting for a wager at a rolling disc. The flesh of a wild-boar more than two years old is decidedly bad—tough and hard; that of sucklings and porkers, on the other hand, is excellent, and the head and snout are particularly esteemed.

The domesticated races have arisen from numerous crosses between varieties originally reared in the country to which they belong. Our wild-boar, and another smaller variety with longer legs, the wild-boar of the lake-dwellings (*Sus palustris*), the wild-boars of India and the Sunda Islands, perhaps even the river-hogs of Africa have contributed to the production of these races, in which domestication and selection have given rise to remarkable characters—hanging ears, head truncated behind, face marked with folds and furrows, shortened snout, and other characters which are described in detail by Nathusius and Rütimeyer, but which we cannot enter upon here.

The **African Hogs** are distinguished by bony excrescences on the sides of the face.

In the **River-hogs** (*Potamochoerus*) these excrescences form two rounded and not very prominent swellings. In the illustration on the opposite page is represented the oldest

¹ That is, in Germany.—Tr.

known species, the **Red River-hog** of Guinea (*P. porcus (penicillatus)*), fig. 153, which attains the length of rather more than three feet exclusive of the tail. The river-hogs are distinguished from ordinary pigs by their more slender forms, longer legs, thinner bellies, and especially by the dentition, which always

wants one premolar, so that they have only 40 teeth in all. The bristles are finer, and are greatly elongated on the middle line of the back, on the abdomen, and on the sides of the face where they form whiskers. The most striking external character consists in the form of the ears, which are long pointed



Fig. 153.—The Red River-hog (*Potamochoerus porcus*).

paper-cornet-like organs, the points of which are considerably prolonged by tufts of fine bristles. It is on account of this structure that a name meaning “tufted hogs”¹ is applied to the members of this genus in German. The species shown in the illustration above is of a beautiful dark orange-brown colour; the brow, cheeks, ears, and slim legs are black; the ear-tufts, whiskers, eyebrows, and mane white; the delicate long snout of a grayish colour. It is the most highly coloured of all pigs. Another species with a less variegated coat was discovered by Stanley near Lake Tanganyika. The very agile young ones of this species have a striped coat. They live in troops in marshy districts. In captivity

¹ Pinselschweine.

they are comparatively gentle animals, yet liable to accesses of sudden fury.

The **Wart-hogs** of Africa (*Phacochoerus*) certainly form one of the ugliest types known among animals. Two species are distinguished, the **Emgalo** of the Cape (*Ph. aethiopicus*) and that of Inner Africa (*Ph. africanus*), which is spread over the whole of Africa from the shores of the Red Sea to the ocean. The distinctions between the two species are not very important. The first has a shorter head, broader snout, more prominent cheek-swelling, and more readily loses the incisors with advancing years.

The wart-hogs, fig. 154, are of the size of a wild-boar, with enormous head and long legs. The body is almost naked, of a dirty

gray colour, and set with coarse bristles very sparsely scattered, except on the middle line of the back, where they form a pretty long mane which hangs down on both sides. The cheeks are surrounded by whiskers, and the short tail carries a tuft. The head forms the

fourth part of the whole length of the body. Behind, it terminates abruptly in the form of a quadrangle, at the upper corners of which are situated the broad, short, sharp-pointed ears, while small prominent eyes are placed on the flat brow. Two warty protuberances



Fig. 154.—The Emgalo or Ethiopian Wart-hog (*Phacochoerus aethiopicus*). page 69.

as large as the ears rise beneath and in front of the eyes like two short, flattened, recurved horns. A second pair of small warts is found on the sides of the face near the enormous tusks, to form which the upper and lower canines are set close together so as to form terrible weapons curving upwards and backwards. The snout is short, but very broad, and oval in section. The legs are pretty long, but strong, and on the joints of the wrist there are broad callosities or warty patches. In order to be able to turn up the soil with greater force the wart-hogs have acquired the habit of kneeling on these patches and advancing by pushing with the hind-feet.

The dentition is very remarkable, unique

in its kind. In the premaxilla there is only a single incisor on each side, and this is placed behind a bony eminence supporting the snout. This pair of incisors, which bend inwards towards each other, often disappear, especially in the Cape species. In the lower jaw there are six incisors arranged in a semi-circle, and these also in the Cape species often disappear in the adult. The upper canines are of enormous size, set in projecting sockets, and have their anterior surface grooved and worn away at the base by friction against the slender and very sharp-pointed canines of the lower jaw. In each half of each jaw the last of the cheek-teeth is of enormous size, and takes up almost the whole length of the jaw, while in front of it

there are a few small blunt rudimentary premolars, which gradually get squeezed out by this huge molar, or, so to speak, become included in it. Thus in the skull of a wart-hog which I now have before my eyes, there are three premolars above and below on the right side and only two on the left, where the

large molar has undergone an elongation which enables it to replace both in form and size the absent premolar. The large molar is at least six times as long as it is broad, and its chewing surface, which is always getting worn away while in use, consists of a double series of oval tubercles surrounded



Fig. 155.—The Babirusa (*Porcus babirusa*).

by enamel, eight to nine in each row, between which a number of smaller tubercles similarly isolated are arranged like squares on a chess-board. These large molars, it will be seen, are very similar in structure to those of the elephants.

The wart-hogs live in troops in marshy regions, and have a certain reputation for savageness and untamableness. The natives of the Cape dread them more than they do the lion. The wart-hogs are fond of hiding in the holes of other digging animals, and sometimes they dig pits for themselves. Specimens are now often to be seen in zoological gardens. They are not very sociable, and show no interest in anything, but are rather fond of having their unshapely head scratched.

Nevertheless one must constantly be on one's guard against them. The first specimen brought to Europe killed its keeper in a moment of fury.

The Babirusa (*Porcus babirusa* (*Babirusa alfurus*)), fig. 155, is a not less remarkable type found on the island of Celebes and some of the neighbouring islands, such as the island of Bouro. It attains almost the size of an ass, having rather long slim legs. The hide, of a dirty grayish-black colour, forms numerous folds, and is set with only a few stiff bristles. The tail is short, pendent, straight, without a terminal tuft; the back is arched. The relatively small head, with longish pointed proboscis, carries paper-cornet-shaped ears and small eyes. The

upper canines have their roots set in sockets which open upwards, and appear as it were glued to the sides of the jaw. They pierce the skin, and in the course of growth get so bent round that the compressed points come to lie on the middle line of the forehead. In profile these teeth have almost the form of a chamois horn. The lower tusks are less curved, more slender, pointed like triangular daggers, and directed outwards. They are not closely applied to those of the upper jaw, but are placed further forwards, and form dangerous weapons. There are in all only four incisors in the upper jaw, six in the lower. Each half of each jaw has two pre-

molars and three molars, the last of which is the largest. In the arrangement of the tubercles of these teeth, which are somewhat like those of tapirs, there is a remarkable tendency to the zygodont form.

The mode of life of the babirussa is like that of the other members of the family. It runs and swims very well, and defends itself with courage when driven into a corner. Specimens have often been brought to Europe, but like other inhabitants of moist tropical climes they have not survived long. A suckling born in a zoological garden was not striped.

Lastly, among the types belonging to the Old World we must mention the **Pigmy Hogs** (*Porcula*), discovered by Hodgson in the Himalayas. They are, in fact, the dwarfs of the group, attaining the length of scarcely two feet. The tail is only a stump. The incisors of these animals remain undeveloped.

The fourth digit on all the feet remains much smaller than in all other *Suida*. Nothing is known of the mode of life of these animals, which obviously approach the ruminants in the characters mentioned.

The American **Peccaries** (*Dicotyles*) likewise form a separate group approaching the ruminants in the division of the stomach into three parts and the loss of the outermost

digit of the hind-feet. They have only two incisors in each half of the premaxilla, and often lose the outer pair. The canines are short, but very strong and sharp-edged; they do not project beyond the lips. The upper ones are not directed upwards, but, as

in the ruminants, downwards. Moreover the peccaries do not butt, but bite.

They are pretty little animals, for the smaller species, the **Collared Peccary** (*D. torquatus*), fig. 156, which inhabits the mainland of America as far north as Mexico, is only about three feet in length; while the larger species, the **White-lipped Peccary** (*D. labiatus*), grows to a length of little more than three feet and a half. The body is short and thickset, the neck very thick, the head thick behind, becoming finely pointed towards the snout, the tail rudimentary, the legs slim. The general colour is dark-gray; the stiff and not very thickly planted bristles are longer on the neck and along the middle line of the back. The northern species is marked with a yellowish stripe on the shoulders, forming a sort of collar. They have at most three pairs of teats.

All peccaries have on the back a pretty



Fig. 156.—The Collared Peccary (*Dicotyles torquatus*).

well developed superficial gland, which exudes an oily fluid with a disagreeable penetrating odour. When the animal is killed in hunting this gland must be at once removed with the adjoining part of the skin, otherwise the highly palatable flesh of the animal would become quite unfit for food.

The peccaries are nomads which roam about in large troops in the forests both by

night and by day. They are not so fond of marshes as other members of the family, are often found hiding in hollow trees, and support each other loyally in battles against beasts of prey, and especially against dogs. They are very zealously hunted, but the hunters always try to single out from the herd a few individuals, which can then be easily mastered.

GROUP OF THE TWO-TOED ARTIODACTYLA OR RUMINANTS

(DIDACTYLA OR RUMINANTIA).

We have already drawn attention to the principal characters of this group, and these we will now only shortly summarize.

The feet are always two-toed, the toes are encased in hoofs and mostly articulated to a single long metacarpal or metatarsal bone, which is only rarely divided longitudinally, but for the most part exhibits a trace of the fusion that has taken place in a longitudinal groove of greater or less depth. The two latent digits never touch the ground, and carry more or less well developed accessory hoofs. But if, on the one hand, the metacarpal and metatarsal bones belonging to these digits remain for the most part more or less distinct, in other cases they are rudimentary, and in others again they vanish altogether with the toes themselves. There is thus a series of developments by which the two lateral digits get more and more reduced, and this series is the continuation of that which was presented by the preceding group. At the same time the limbs become more slender and longer, as the fleetness of the animal increases. Among the ruminants we meet with runners which surpass all other known mammals in point of speed.

In many ruminants there are found on the hoof-bearing joints of the toes special sacs formed of folds of the skin lined with hair, at the bottom of which open numerous glands, from which an oily, often strongly smelling, fluid is exuded. The presence of these so-called interdigital glands often serves to distinguish genera and groups of genera. The dentition displays very characteristic evolutionary series, but confined within pretty narrow limits. In the first place there is observed a tendency to dispense with the upper incisors, which often begin to appear in the embryo, but remain undeveloped except in the camels, in which a single incisor survives in each premaxilla. A callous pad covering the edge of the jaw takes on the function of the absent teeth. On the other hand, the number of incisors in the lower jaw is brought up to eight, which are united in a semicircle and placed almost horizontally. This increase perhaps arises in most cases from the fact that the lower canine assumes the form of an incisor and gets attached to the series of true incisors. The upper canines remain longer distinct, but in the hollow-horned ruminants and the giraffes they

disappear altogether. The true cheek-teeth are always formed of semi-cylinders, which, through the disposition of the enamel, exhibits on the chewing surface a half-moon, the convexity of which in the upper cheek-teeth is turned inwards and in those of the lower jaw outwards. The selenodont (moon-shaped) type of dentition is here accordingly developed in all its purity. The premolars readily fall into two groups. The first frequently stands near the incisors and canines, so that it is separated from the others by an interval or diastema, while the originally simple hinder premolars become associated with the true molars both in position and form. Since the function of the cheek-teeth consists specially in the bruising of the grass by a lateral grinding motion, the condyle, or joint-surface at the end of the lower jaw, has the form of a longish, transversely-placed cylinder.

Even in some members of the hog family, those, namely, belonging to Africa, we may observe a tendency to the formation of bony outgrowths on the skull, these having the appearance of swellings. In the ruminants we can trace step by step the growth of such bony excrescences, which, according to their structure, are called horns or antlers. The original types of the ruminants had no horns, which are likewise entirely wanting in some still living families, as the camels and the musk-deer. Three different forms can be distinguished in these weapons, which are often developed only in the males, and, in any case, are always stronger and larger in them than in the females. In the giraffe a bony knob rises in the middle of the brow a little behind the eyes, and two short horns are formed just at the back of the head between the ears. They have bony cores which are connected by sutures with the bones of the skull. All these protuberances are covered by the quite unmodified hairy skin. From this primitive structure of a simple bony peg, so to speak, covered with skin, have been developed, on the one hand, horns, on the other, antlers.

In the former we have a solid or hollow bony core completely fused with the skull and traversed by numerous vessels, the canals through which these run giving a spongy or striped appearance to the internal structure. This permanent core is covered by a hard sheath, which, like the nails and hoofs, is composed of horny fused fibres. These horny sheaths keep constantly growing by the addition of new layers internally. They can easily be separated from the bony core, with which they are connected only by vessels and the soft tissue out of which the horny substance is formed. Like the hoofs they persist throughout life, and at the lower part, where the bony core enters them, they are hollow. It is the family of the **Hollow-horned Artiodactyla** (Cavicornia) the members of which are furnished with horns of that sort.

The antlers of the **Deer** are formed in a different way. From the hinder and upper angles of the frontal bones there rise processes or protuberances known as *bosses*, which belong to the bone itself, and like it are covered by the hairy skin. These processes, usually very short, may attain, as in the case of the muntjac, a considerable length, and are manifestly analogous to the horns of the giraffe. But in the deer they spread out at the end into a disk surrounded by a ring of bony knots forming the *burr*. On the disk may be observed at certain times what is nothing else than an inflammation, which leads to the extraordinarily rapid growth of a true bone traversed by numerous vessels and covered by a thin layer of skin with short hair. During the growth of this bony process the number of blood-vessels is remarkable, and the circulation of the blood in the growing bone is very active. But as soon as the bone has attained its full length the circulation gradually slackens, and ultimately it ceases altogether. The skin becomes dry, breaks off in fragments, and the whole antler dies. It still remains for a time attached to the burr, but finally it breaks off in order to give

place to a new antler. Except in the case of the reindeer only the male deer carry antlers, and their formation is intimately related to the sexual function. A castrated stag produces no new antlers after the shedding of those which it had at the time of the mutilation, or these latter may be permanently retained. Originally all antlers are simple spikes or *snags*, and it is only in course of the periodical renewals that we see the formation of the lateral shoots or *tines*, which are sometimes expanded and flattened.

Notwithstanding the amount of difference between horns and antlers there is yet a connecting link in the **American Prong-horned Antelope** (*Antilocapra americana*), the tines of whose antlers are covered with horny sheaths as in the Cavicornia, sheaths formed of a thickened and hardened epidermis or outer skin, but which are shed and renewed several times in the process of growth, fresh ones budding off round the bony cores.

The structure of the stomach in the present group is likewise remarkable. It is this which gives rise to the process of rumination. All the members of the group are exclusively herbivorous, and most of them can escape from their enemies only by their fleetness of foot. They accordingly consume great quantities of herbs and leaves with the utmost haste, filling therewith a capacious compartment in their stomach, which serves as a sort of storehouse, and then betake themselves to some retired spot where they can perform the second mastication at their leisure. Since the first mastication is very imperfect and does not suffice for the extraction of the nutritive matter contained in the herbs and leaves, such an arrangement is all the more advantageous, inasmuch as it permits of a more intimate mixture of the food with the saliva. The structure of the stomach is manifestly due to the necessity for returning to the mouth the material stored up in the large compartment above mentioned in order that it should be finely ground by the action of the

teeth. The stomach is first divided into two parts, one which serves as a storehouse, and the other which carries on the proper work of digestion. The first part is in direct connection with the gullet through the cardiac opening, the second part is continued by the pyloric opening into the intestine. Now each of these parts is again divided into two



Fig. 157.—The Kanchil (*Tragulus pygmaeus*). page 76.

subordinate compartments, those of the cardiac portion being the **paunch** or **rumen**, which is always very capacious and often forms several secondary pouches, and the **reticulum** or **honey-comb** stomach. Into these two compartments the food is first admitted, and from the reticulum it can ascend again to the mouth through the gullet, which is widely expanded for the purpose. But the gullet has throughout its whole length a thick-lipped groove opening into the cavity of the pyloric section of the stomach, which pyloric section is subdivided into the **liber**, **psalterium** or **manyplies**, and the **abomasum** or **rennet** stomach. The remasticated food glides down the groove just mentioned, the lips of which shut so as to form a tube, and passes thence directly into the psalterium, and from there

into the abomasum, in which is secreted the acid gastric juice by which the work of digestion is performed. In young ruminants still sucking, the paunch and reticulum are only slightly developed; these organs attain their full size only as the animals pass over to a purely vegetable diet. There are numerous variations in the structure of these different parts of the stomach, but the most remarkable is that seen in the chevrotains (*Tragulida*), in which the psalterium is altogether absent, which brings about a close resemblance between their stomach and that of the peccaries. The teats are situated in the region of the groin. The young come into the world in a very advanced state, and are able to follow their mothers a few hours after birth. They are not numerous; one, or at most two, at a birth is the rule in the ruminants.

THE CHEVROTAIN FAMILY

(*TRAGULIDA*).

This family stands nearest to that of the pigs, and especially, as just stated, to the peccaries, in virtue of the structure of the stomach, which has no psalterium; and also in virtue of the structure of the feet, in which the metacarpal and metatarsal bones are not yet completely fused; the structure of the brain, which is very simple, has few convolutions, small cerebral hemispheres, and the cerebellum, often even a part of the mid-brain, uncovered; and lastly, in virtue of the structure of the placenta.

They are the smallest of the ruminants, for the **Kanchil** (*Tragulus pygmaeus*), fig 157, does not exceed the size of a hare, and the **Water Chevrotain** (*Hyæmoschus* (*Hyomoschus*) *aquaticus*), the largest species, is of about the size of a roebuck a few months old. The family is represented only by the genera just mentioned. The true chevrotains, forming the genus *Tragulus*, in which several species are distinguished, are indigenous in India, the

Eastern Peninsula, China, Ceylon, and the Sunda Islands; the water chevrotain is confined to the west coast of Africa—the Gaboon and Sierra Leone. The head of the *Tragulida* is finely shaped and pointed in front. In the males two sharp, slender, pointed canines curved downwards and outwards project beyond the mouth from the upper jaw. The eyes are very large and sparkling, the ears small and but slightly covered with hair, the neck short, the body thick, the back arched, the legs slender and well formed, the tail short and bushy. The fur is short, very thick, usually of a yellowish-brown colour, almost white underneath, and often marked with white stripes and spots on the throat and sides. The lateral digits are well developed, and are carried by complete metacarpal (or metatarsal) bones; the lower incisors are set close together, and the middle pair has the crowns spread out like a spade. The lower canines are absent. The three premolars above and below are simple, with sharp triangular crowns. The three upper molars exhibit double crescents, while on those of the lower jaw there are only single crescents on the edges. There are no horns, and the males have no musk-pouch. These pretty little creatures live singly or in pairs in mountainous regions. They are very agile, leap and climb admirably, run well, but not long at a time; and among the Malays, who have a saying, “as cunning as a kanchil,” enjoy a perhaps exaggerated reputation for craftiness. They feign death in order to escape pursuit. They are eagerly hunted for their flesh, and they have often been brought to Europe, where they thrive very well in the zoological gardens; they are graceful, but very shy and timid.

The **Musk-deer** (*Moschus moschiferus*), fig. 158, forms the connecting link between the chevrotains and the true deer. Like the former, it has no horns, has a pretty thick body highly arched behind, large accessory hoofs and strong canines, which in the males

project beyond the mouth; but in respect of all the other characters of the dentition, the limbs, the whole skeleton, and the stomach and intestines, are in no way different from the true deer. On these grounds Alph. Milne Edwards has separated the musk-deer from the chevrotains, with which they were formerly united in the same group.



Fig. 158.—The Musk-deer (*Moschus moschiferus*).

What distinguishes this species, which is distributed over an enormous range in all the mountainous parts of Central Asia, from Siberia to Cochin-China, and from Kamchatka to the Ural Mountains, is the pouch, which stands in close relation to the sexual organs of the male, and yields the musk, which was formerly highly esteemed in medicine, but at the present day is used almost exclusively in perfumery. The musk-pouch is a fold of the skin as large as the fist which opens in the middle line of the abdomen behind the navel, and contains numerous glands which excrete an oily substance of a yellowish-red colour, becoming brown on drying. The pouch of an adult male may contain as much as two ounces of the precious substance, or even

more, and it is chiefly for the sake of this product that the very shy and agile animal is hunted. The musk-deer is of the size of a roebuck, and like this animal has a stiff coarse hair-covering, which is very variable in colour. Reddish-gray is, however, the prevailing hue, but white-spotted and even quite white varieties are found. The musk-deer hides itself by day and goes out in search of pasture at sunset. It jumps and climbs about on the mountains as cleverly as a chamois; but since it is much attached to its own retreats, and always returns thither after an excursion, it is easily caught in snares or shot with bullets. The Siberian musk is the least highly prized; nevertheless this country yields about 0000 pouches every year.

THE DEER FAMILY

(CERVIDA).

By the exclusion of the musk-deer from the deer family this group is restricted to those ruminants which possess antlers, which are always developed in the males, but seldom in the females. The males almost always have canines also, which in some species even grow to a considerable size, but in most cases remain small and insignificant. The eight lower incisors form a close-set series, and are almost alike in form and size. The premolars are very little different either in form or size from the true molars. Deer have large ears, prominent eyes, and always have under the eye lachrymal glands or tear-pits exuding an oily fluid which in the breeding season acquires a peculiar smell. The tail is very short, the body usually long, and covered with coarse, stiff, thickset hair. The long slender legs carry small accessory hoofs at a considerable height above the ground. Between the hoofs of the hind-feet there is a brush of stiff hairs. Polygamy appears to be the rule in the deer family; they seldom live in pairs, almost always in

herds. They prefer the woods, are shy and sudden in their movements, but the males become quarrelsome and even ferocious in the rutting season, when they utter loud bellowings and carry on furious battles with one another. The family is distributed over the whole of the Old and New Worlds as far as the limit of forests, occasionally even beyond that limit, and everywhere they are the objects of keen pursuit, for the sake of their tender flesh, their hide, which furnishes pretty good leather, and even their antlers, which are used in the making of instruments and works of art. The females have four teats, but seldom bring forth



Fig. 159.—The Muntjac (*Cervulus muntjac*).

more than one young one at a time. Hearing is the most highly developed of all the senses; the intelligence is very slight. Beautiful, but stupid! is the motto for them.

The very numerous family of the deer has been divided into genera and sub-genera, regard being had, in making these subdivisions, chiefly to the form of the antlers, which are sometimes simple spikes, sometimes forked, branched, or spatulate—expanded somewhat like a spade. The distinctions are, however, very slight, so that no great value can be attached to these subdivisions. From these groups we select a few characteristic or specially interesting species.

Through the possession of large projecting canines by the male and the absence of bunches of hair on the soles of the hind-feet

the Muntjac (*Cervulus muntjac*), fig. 159, also called by the natives **Kidang**, approaches the musk-deer, while in all other characters it is a member of the true deer family. The muntjac lives on the Great Sunda Islands, Borneo, Java, and Sumatra; an allied but little-known species inhabits India. These pretty deer, of the size of our roe, are distin-

guished by the structure of the antlers, the velvet-clad portions of which begin in the form of two strong lateral bony ridges on the nose, and rise free above the brow to a height equal to about half the length of the head. At a point a little way above the burr there rises a short **brow-**

tine, while the stem or beam is continued in a form like that of a bow with the concavity inwards. The fawns are spotted; the adult animals have a brownish-yellow coat, with two white spots on the throat; the tear-pits are very large and surmounted by tufts of hair. The males live solitary in the woods, associating with the females only in the breeding season, are very courageous, and can defend themselves very well against dogs with their horns and teeth. In confinement they are subject to accesses of fury which may prove dangerous at times.

South America nourishes several species of small deer about equal in size to our roe-deer, but even more slimly built. These are distinguished by the name of brockets (genus *Subulo*) on account of their small, somewhat



To face page 78.

PLATE XXIV. — THE ROE-DEER (*Capreolus vulgaris*).



curved, pointed antlers without tines. An illustration is given of the commonest species, the **Red Brocket** (*Subulo (Cariacus) rufus*), fig. 160, which has a coat of a brilliant reddish-brown colour on the back and reddish-yellow underneath. This very timid animal lives in pairs in the densest parts of the forests of Brazil and Guiana. The tail is short, the tear-pits are slightly developed. Canines are present only in the young males.

Our **Common Roe** (*Capreolus vulgaris (caprea)*), which is represented in Pl. XXIV., is the type of a group characterized by having short strong antlers with a thick, round, straight beam, the end of which forks one or more times with increasing age. The tear-pits are scarcely indicated, the tail is only a

stump, the canines are present only in the young males. The roe-deer lives in small troops scattered over all Europe. A larger variety extends over Central Asia as far as China. The general colour is brownish-gray. The very stiff fur is shorter and redder in summer, longer and grayer in winter. There is a white patch on the hips behind known to hunters as the speculum. The males in the rutting season are very combative and challenge one another with a peculiar cry, which in hunting is sometimes imitated by means of a small instrument placed in the mouth. The roebuck imagines that he hears the voice of a rival and at once dashes to meet him. At other times the roe is a timid animal, hiding by day in the dense parts of the forest, but preferring the neighbourhood of open glades and fields. The troops go

out only at night under the leadership of an old male. The roe yields us the most highly esteemed kind of game. The pregnancy of the female presents an exceptional condition like that which we have already observed in bats. The ovum is impregnated in July and August, but only in November does it begin to develop, and the young are born in May. Roes have often been tamed, but the instances

have remained isolated, since the bucks become very ill-tempered as they grow old.

The members of the genus *Blastoceros* (sometimes included in the genus *Cariacus*) take the place of our roe-deer in S. America. The commonest species, the **Pampas Deer**, or **Guazui** of the natives (*Bl. (Cariacus) campestris*), is represented in fig. 161.



Fig. 160.—The Red Brocket (*Subulo rufus*).

They are distinguished from the roes by their longer tail and larger and thinner antlers, which besides the terminal peak carry two or three long, thin, and sharp-pointed tines. The species represented is of the size of a small fallow-deer, with very long slender legs. The under parts are white, and the eyes are surrounded by white rings. This pretty creature prefers the pampas and treeless steppes, which, however, are covered with tall grasses in which it hides by day. It is easily tamed, and becomes very confiding, but the male in the rutting season has such a penetrating and clinging smell that it becomes a very disagreeable guest, while its flesh is rendered quite unpalatable.

In the East Indies there are numerous forms allied to those just described, forms in which the antlers attain the length, and

exhibit in the beams the roundness and curvature characteristic of our common deer, but scarcely ever give off more than three tines, one of which, the brow-tine, is situated near the burr above the eyes.

As type of this group an illustration is given of the **Axis** or **Spotted Deer** (*Axis maculata* (*Cervus axis*)), fig. 162, whose

beautiful brownish-yellow fur is marked with a dark stripe on the back, and is dotted over with numerous white spots. The antlers are thin and almost smooth. This beautiful stag, which does not quite attain the size of the fallow-deer, inhabits the jungles of India. It is often hunted. It is propagated pretty easily in our zoological gar-

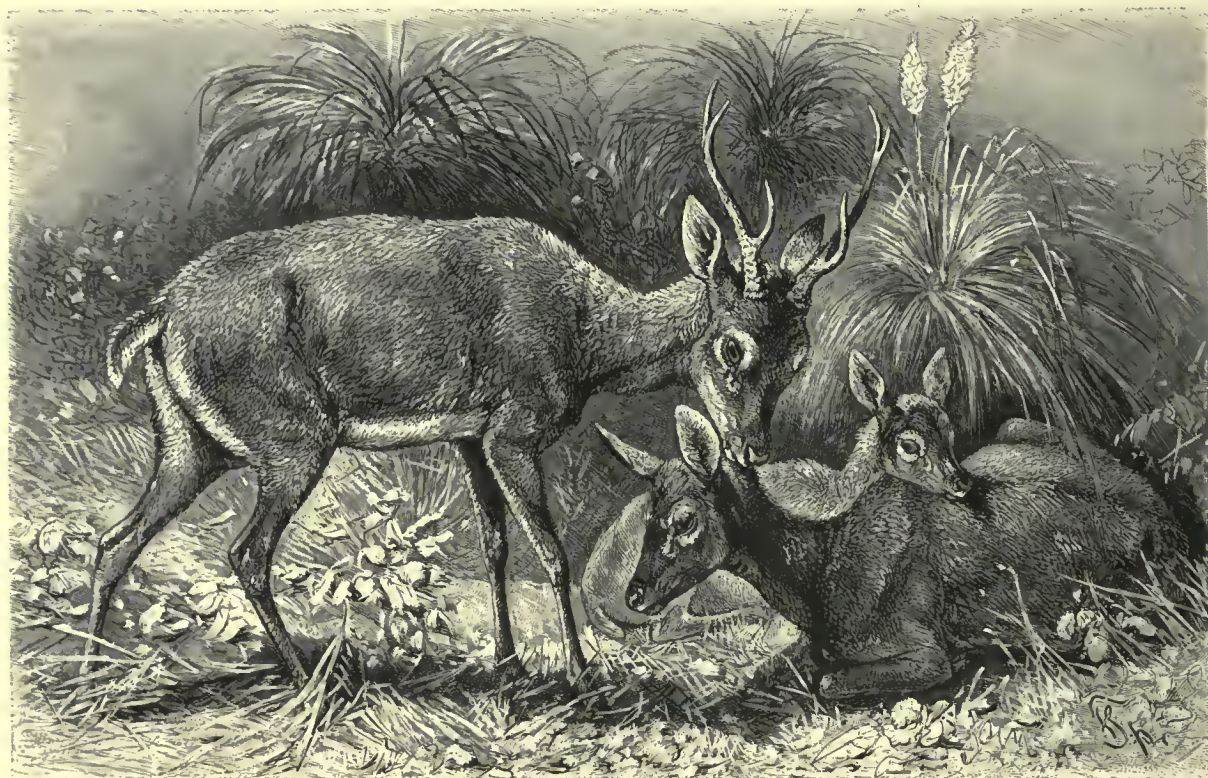


Fig. 161.—The Pampas Deer or Guazui (*Blastoceros campestris*). page 79.

dens, but can scarcely stand the cold of our winters.

[A close ally of this species is the sambur or sambar deer (*Cervus Aristotelis*), which in Ceylon, where it is much hunted, goes under the name of the "elk." The hunting of this deer is described by Sir Samuel Baker in the following enthusiastic terms in his *Rifle and Hound in Ceylon*:—

"It is a glorious sport certainly to a man who thoroughly understands it; the voice of every hound familiar to his ear; the particular kind of game that is found is at once known to him long before he is in view by the style of the hunting. If an elk is found the hounds follow with a burst straight as a line and at a killing pace directly up the hill, till he at length turns and bends his headlong course for some stronghold in a deep river to bay. Listening to the hounds till certain of their course,

a thorough knowledge of the country at once tells the huntsman of their destination, and away he goes.

"He tightens his belt by a hole, and steadily he starts at a long swinging trot, having made up his mind for a day of it. Over hills and valleys, through tangled and pathless forests, but all well known to him, steady he goes at the same pace on the level, extra steam downhill, and stopping for a moment to listen for the hounds on every elevated spot. At length he hears them! No; it was a bird. Again he fancies that he hears a distant sound—was it the wind? No; there it is—it is old Smut's voice—he is at bay! Yoick to him! he shouts till his lungs are well-nigh cracked; and through thorns and jungles, bogs and ravines, he rushes towards the welcome sound. Thick-tangled bushes armed with a thousand hooked thorns suddenly arrest his course; it is the dense fringe of under-wood that borders every forest; the open plain is

within a few yards of him. The hounds in a mad chorus are at bay, and the woods ring again with the cheering sound. Nothing can stop him now—thorns, or clothes, or flesh must go—something must give way as he bursts through them and stands upon the plain.

"There they are in that deep pool formed by the river as it sweeps round the rock. A buck! a noble fellow! Now he charges at the hounds, and strikes the foremost beneath the water with his fore-feet; up they come again to the surface—they hear their master's well-known shout—they look round and



Fig. 162.—The Axis or Spotted Deer (*Axis maculata*).

see his welcome figure on the steep bank. Another moment, a tremendous splash, and he is among the hounds, and all are swimming towards their noble game. At them he comes with a fierce rush. Avoid him as you best can, ye hunters, man and hounds!

"Down the river the buck now swims, sometimes galloping over the shallows, sometimes wading shoulder-deep, sometimes swimming through the deep pools. Now he dashes down the fierce rapids and leaps the opposing rocks, between which the torrent rushes at a frightful pace. The hounds are after him, the roaring of the water joins in their wild chorus, the loud holloa of the huntsman is heard above every sound as he cheers the pack on. He runs along the bank of the river, and again the enraged buck turns to bay. He has this time

taken a strong position; he stands in a swift rapid about two feet deep, his thin legs cleave the stream as it rushes past, and every hound is swept away as he attempts to stem the current. He is a perfect picture, his nostrils are distended, his mane is bristled up, his eyes flash, and he adds his loud bark of defiance to the din around him. The hounds cannot touch him. Now for the huntsman's part; he calls the staunchest seizers to his side, gives them a cheer on, and steps into the torrent knife in hand. Quick as lightning the buck springs to the attack; but he has exposed himself, and at that moment the tall lurchers are upon his ears; the huntsman leaps upon one side and plunges the knife behind his shoulder. A tremendous struggle takes place—the whole pack is upon him; still his dying efforts almost free him from their hold, a

mass of spray envelopes the whole scene. Suddenly he falls—he dies—it is all over. The hounds are called off, and are carefully examined for wounds."

Elsewhere the same writer records another striking incident in elk-hunting. "One great pleasure," he says, "in the hunting at Newera Ellia is the ease with which it is obtained. In fact, the sport lies at the very door. This may be said to be literally true, and not a *façon de parler*, as I once killed an elk that jumped through a window. It was a singular incident. The hounds found three elk at the same time on the mountain at the back of the hotel at Newera Ellia. The pack divided; several hounds were lost for two days, having taken their elk to an impossible country, and the rest of the pack concentrated upon a doe, with the exception of old Smut, who had another elk all to himself. This elk, which was a large doe, he brought down from the top of the mountain to the back of the hotel, just as we had killed the other which the pack had brought to the same place. A great number of persons were standing in the hotel yard to view the sport, when old Smut and his game appeared, rushing in full fly through the crowd. The elk was so bothered and headed that she went through the back-door of the hotel at full gallop, and Smut, with his characteristic sagacity, immediately bolted round to the front of the house, naturally concluding that if she went in at the back-door she must come out at the front. He was perfectly right; the old dog stood on the lawn before the hotel watching the house with great eagerness. In the meantime the elk was galloping from room to room in the hotel, chased by a crowd of people, until she at length took refuge in a lady's bed-room, from which there was no exit as the window was closed. The crash of glass may be imagined as an animal as large as a pony leaped through it; but old Smut was ready for her, and after a chase of a few yards he pulled her down."]

In the **True Deer** (*Cervus*) the round antlers become very large, and have an additional tine added to them every year; at first a simple shoot each branch may come to bear ten or even more tines or prongs. Since our **Common Stag** or **Red-deer** (*Cervus elaphus*), Pl. XXV., is so highly esteemed as an object of the chase the increase in the number of the tines is a subject which has

been closely studied, and books on hunting are filled with minute details regarding animals with ten and twenty tines or even more. We cannot here enter upon these particulars any more than we can take account of the refined investigations which have enabled hunters to judge of the age, sex, size, and weight of an animal from the impressions of its hoofs—their size and degree of divergence.

The red-deer, which is shown in Plate XXV., is a beautiful well-formed animal with a majestic bearing, of a reddish-gray colour, about 5 feet high at the withers, with large ears, large lachrymal glands, and antlers curved upwards and outwards. The tail is pretty short, the fur slightly spotted in the young animal. The stag prefers the depths of the forests, defends itself bravely against depredators, and at the season of heat is very combative; this occurs in September and October, and then the male may be heard challenging his rivals to fight with hoarse trumpet-like tones, which resound to a great distance. The older the stag is the deeper is the sound that it emits. Formerly it was the practice in hunting the stag to imitate this sound by means of small horns specially made for the purpose, and in order all the more surely to attract the animal the horns were made to resemble the sound of a comparatively weak stag.

Several allied species, such as the **Wapiti** or **Canadian stag**, the **Persian Deer**, and others, have been distinguished. All these presumed species appear to us to be only geographical varieties, the distinctions between which are of little moment. Thus the wapiti, for example, is certainly much more powerful and much taller than our European stag. Its antlers are much stronger, and animals with twenty tines are no rarity in Canada. But in the middle ages our stag reached a much greater size than it does now, and the numerous antlers which have been collected in the neighbourhood of lake-dwellings are so



To face page 82.

PLATE XXV. — THE RED DEER OR STAG (*Cervus elaphus*).

thick and have so many tines that they would have to be assigned to the wapiti rather than to our stag. All these stags have the same habits, the same keenness of sense, the same savage impulses at the breeding season, and we are obliged to add the same stupidity. Notwithstanding repeated efforts at domestication, they remain but little adapted for the companionship of man, but for all that excellent animals for the chase.

If the varieties are considered as belonging to the same species as the red-deer, the territory occupied by this species is a remarkably large one, extending as far as the limit of forests in the temperate zones of both hemispheres. Everywhere the red-deer is hunted with eagerness, although its flesh is not very much to be recommended, for, according to our experience, it resembles tough beef with thick fibres. But for the sportsman the chase of the stag has always been one of the keenest of pleasures. The chase proper is rather an exercise in horsemanship than a true hunt. Almost everywhere in civilized Europe the stag has given way before the persecution which it has well deserved on account of the devastation which it commits in fields and forests. It is now seldom found except in the large inclosures reserved for game.

[Of the species or varieties above referred to the commonest in America is that known as the *Cariacou* (*Cervus virginianus*). It is smaller and more elegant than the red-deer, and throughout the southern part of North America, as far as 43° N., it is a favourite object of the chase. This deer is the one which American sportsmen have the most frequent opportunities of hunting. "It is where the country is divided into ranges of wood-clad mountains, or high hills divided by valleys, down which rivers or creeks run, or in which lakelets are situated, that the proper theatre is found for running the deer with hounds. For this purpose packs of greater or less number are kept as in different parts of Europe. In such localities different runways are adopted by the deer, where they pass the water-courses in going from one elevation to another, or where they approach the

little lake for bathing. Several sportsmen engage in the hunt. Early in a still, frosty morning they repair to the ground, generally on horseback, when one, and sometimes two, are stationed at each of the well-known runways, when their horses are concealed and the hunters secretly station themselves so as to command the crossing place and its approach. The hounds, in lead, are sent on to the mountains, and at a likely place they are slipped, and the hunt commences. So soon as the deer is started, the hounds give tongue. This is the signal anxiously listened for by the watchers at the several runways. Far away in the distant mountain, at first like a faint murmur, the sound is heard, uncertain whether it is the baying of the dogs or the whisper of an insect. The note soon becomes more distinct, and it is certain that the game is afoot. Anxiety now increases to determine who occupies the favoured location. All along the line the attention of each watcher is strained to the utmost tension, to detect by the sound the course selected by the deer. Rifles are cocked, not a whisper is breathed, not a twig is broken, not a leaf is stirred. Every wandering thought is summoned back and absorbed in the excitement of the moment. The course of the hounds may be traced by their voices, each listener calculating the chances of their arriving at his stand.

"This is the moment when the inexperienced hunter is liable to make his greatest mistake. He forgets that the deer is not with the dogs, but may be a mile or more ahead of them. He listens to the dogs, and his eyes are in the direction whence the sound comes. If they seem to approach him, he forgets that the game may be already upon him. When he least expects it there is a rushing noise, a crackling of the bush, and the deer emerges from the thicket, and with an elastic bound is already at the ford, and with a few lofty leaps is across the creek, and like a flash disappears in the dark covert beyond, before the startled watcher, quaking from head to foot with the *buck-fever*, could more than bring his gun to his face and fire a random shot, when all is still again, save the tumultuous beating of his own heart.

"Less fortunate is the deer if he makes the runway occupied by the experienced sportsman. Only thinking of the danger behind him, and confident of his powers to far outstrip the baying pack, he bounds through the forest, proudly throwing aloft his great branching antlers, as if in derision, bidding defiance to his pursuers, nor dreaming of danger before, he fearlessly rushes to the little opening on

the bank of the stream, where he is accustomed to make the crossing, whether at his leisure or when pursued. This is just what the watcher is hoping and expecting. While he hears the distant baying of the pack, he is intently listening for the least noise in the near forest which could indicate the approach of the game. And now he hears the breaking of a dry limb, or the heavy tramp among the rustling leaves. If his pulse quickens a little, as it surely will, still no tremor or agitation is felt, but only tension and firmness are established in every nerve and in every muscle. The trusty rifle is quickly brought to the cheek, and the next instant, with a lofty bound, the magnificent but graceful form of the stately stag bursts from the border of the covert, his face in a horizontal line, his antlers thrown back upon his shoulders, so that every branch and vine must easily glance from the backward pointing tines, his seat erect, and his bright eye glistening in the excitement of the moment, when instantly and while he is yet in mid-air, a sharp report is heard, when, to use a hunter's expression, 'he lets go all holds,' his hind-feet, propelled by the great momentum, are thrown high in the air as if his very hoofs would be snapped off, and he falls, *all in a heap*, or turns a complete somersault, and then rolls upon the ground pierced through the heart, or with both fore-shoulders smashed. . . . It is a glorious moment, and unsurpassed by human experience. I have been there, and know how it is myself, and so I speak from knowledge. Had the deer been standing, and with a full inspiration, he might have made a few bounds before he fell, but in the position described he could never rise again."—Caton, *The Antelope and Deer of America*.]

A group less rich in species is formed by the Cervida with broad shovel-like antlers, in which the beam and the tines show a tendency to become flat.

The **Fallow-deer** (*Dama vulgaris*), shown in Pl. XXVI., is still to be seen in our inclosures for game. Its home was Central and Southern Europe, including the Asiatic and African countries bordering on the Mediterranean. In point of size the fallow-deer stands between the roe-deer and the stag. It is more thickset and not so long-legged as the latter, but has much shorter and more elegant ears

and a longer tail. Though less in height it is more graceful than the stag, which appears always to serve as the model for the draughtsman. The elegantly curved antlers have a round beam with one or two tines of which the brow-tine stands very near the burr. After the beam has given off these tines it spreads out into a shovel from the edge of which proceed small tooth-like prongs. The colour of the fallow-deer is very variable; in some the coat is spotted like that of a fawn, in others again uniformly reddish, grayish, or even white. The fallow-deer easily accustoms itself to the presence of man, and its flesh is much more tender and palatable than that of the stag.

The **Reindeer** (*Tarandus rangifer* (*Rangifer tarandus*)), fig. 163, is the deer of the polar regions in both hemispheres. With the exception of the elk it is probably the least elegant species in the whole family. The long body is supported by relatively short and thick legs, which have swollen and knotty joints, and end in broad divergent hoofs, and which carry accessory hoofs almost touching the ground. The head is borne horizontally, not erect as in the other deer. It is short, and has a blunt naked muffle. The reindeer is the only species of deer in which the female carries antlers as well as the male. Those of the female are indeed smaller than those of the male, but otherwise resemble the latter very closely in form, although in both the form is very variable. It is indeed impossible to find two reindeer antlers of the same form, or even a single symmetrically formed pair; the two branches of the antlers are always unlike. We must accordingly seek out the common characters from a great number of variations. These consist in a thin flattened beam, which has a well-marked curve first backwards and then upwards, and near the burr gives off two tines within a short distance of each other. At their extremity these tines spread out considerably and frequently even fork again.



To face page 31.

PLATE XXVI. — THE FALLOW DEER (*Dama vulgaris*).



One brow-tine, sometimes the right, sometimes the left, is always longer than the other; it turns and curves inwards so that its blade becomes perpendicular to the middle line of the nose, thus forming a broad spade

which the animal makes use of to sweep away the snow under which it seeks its food. After giving off the two pairs of unlike tines of which we have spoken, the long drawn-out beam of the antler bends round in the manner



Fig. 163.—The Reindeer (*Tarandus rangifer*).

described and terminates in a small blade bordered with very irregular teeth. The coat of the reindeer consists in winter of a thick woolly fur with very long hair, which forms a long mane-like beard under the neck; this dirty-gray winter fur is shed in summer in large tufts disclosing to view the darker and shorter summer hair. The gait of the reindeer even in running is very inelegant; it takes very long strides, and appears rather to slide along the surface than to run. The divergence of the hoofs, which are, moreover, very broad, is admirably adapted to aid its movements across the snow and across

bogs. While walking or running it causes a crackling sound to be heard almost like that of an electric spark; this noise is no doubt produced in the interior of the joints.

The reindeer in the wild state must of course be distinguished from the animal in a half-domesticated condition.

The former is an animal of the plains and high plateaux, which shelters itself in winter in the woods, and only in summer ventures into treeless low grounds. Such are the habits of the wild reindeer in America, Siberia, and even in Lapland. The reindeer has erroneously been considered as a climbing

animal, because naturalists have for the most part observed it only in the Scandinavian Alps. But these highlands have the character of stony plateaux, which indeed are intersected by profound gorges, but spread out into enormous and mostly marshy flats. Upon these high moss-grown table-lands the reindeer is in its element, but not among mountains with narrow valleys with steep sides and without vast level stretches like our Alps or the Pyrenees. I have hunted the chamois and the wild reindeer; there is not the least comparison to be made between these two animals; the one climbs and leaps, the other strides and trots.

The life of many northern tribes is dependent on the domesticated reindeer, which nevertheless remains an awkward stubborn animal, difficult to manage. The Laplander makes use of everything derived from it, even the contents of its stomach, which he boils as a vegetable, and the still warm marrow, which he eats raw. The reindeer is even made use of as a beast of draught. It is led about in large flocks under the conduct of small intelligent dogs, which are highly esteemed by their owners. But the reindeer always remains half wild, and is very apt to return to a state of freedom. It never becomes tame enough to allow of the female being milked before it has been bound by means of a noose thrown over the antlers. The pleasure of riding in a sledge drawn by reindeer is one which most people would gladly leave to the Laplanders, who are accustomed to the somersaults and all the other disagreeables which a wild, stubborn, and stupid mule could cause.

The largest, but at the same time the ugliest of all the deer family is the **Elk** (*Alces palmatus* (*Machlis*)), Pl. XXVII. This species, which at the present day is confined to the tracts bordering on the Baltic on the east and north and to Canada, was during the middle ages an object of the chase in Central Europe, from whence it is now

entirely banished. In Prussia, where the elk was formerly very abundant, there is now only a single forest, that of Ibenhorst, near Tilsit, where a herd has been preserved through the adoption of severe protective measures. The elk ranges from the Baltic provinces, Finland, and the south of Scandinavia, throughout Asia as far as the shores of the Pacific Ocean near the Amur.

It is a large animal, about six and a half feet high at the withers, with a short thickset body and long thick legs, with narrow hoofs connected by loose skin, and accessory hoofs long enough to touch the ground. The head is very ugly; the ears are so large that the female, being without antlers, resembles at a distance a large ass; the eyes are small and without expression. But what specially disfigures the head is the enormously thick and broad loose upper lip, which hangs down over the mouth like a rounded curtain. It is very flexible, and serves admirably for tearing off the shoots, the young twigs, and the bark of the shrubs and trees on which the elk prefers to feed. The muffle formed by this upper lip gives to the head an extremely ugly termination. The fur consists of a short and fine down and long brittle hairs of a gray colour, which form a goat's-beard at the chin, a sort of mane on the back, and a tuft at the end of the short tail. The antlers of the male acquire a characteristic form only in the fifth year. It is only then that the antlers begin to spread out so as to form a broad hollow shovel, on which the tines, the number of which increases with age, are in most cases set in two groups.

The **Canadian Elk**, the **Moose-deer** of the Americans, the **Original** of the French Canadians, is only a geographical variety, which when full-grown is larger and stronger than the elk of the Old World. It answers to our elk as the wapiti does to our stag.

The elk inhabits damp woods containing marshes and peat-bogs here and there. It feeds almost exclusively on willow leaves,



To face page 86.

PLATE XXVII. — THE ELK (*Alces palmatus*).

bilberries, alders, and the bark of shrubs such as grow in the damp and marshy soils which it frequents. Like all members of the deer family, it lives in flocks, which conceal themselves by day and go out in the evening under the leadership of very combative and

even fierce males. The flesh of the elk is tough, coarse, and of an unpleasant taste; but the hide, which is of a very firm texture, is highly esteemed on account of the very good flexible leather which is made from it. Great havoc was wrought among the flocks of elk



Fig. 164. —The Pronghorn Antelope (*Antilocapra americana*). page 88.

in those times when it was thought impossible to have a good cavalry without tightly-fitting leather hose.

THE HOLLOW-HORNED RUMINANTS

(CAVICORNIA).

The family of the hollow-horned ruminants is distinguished, as the name indicates, by the possession of hollow horns, which form cases round bony pegs or processes from the frontal bone.

All typical Cavicornia have only simple horns, without branches, formed over bony axes, which are either, as in the goats, solid and traversed only by the canals of the blood-vessels, or are hollow in the middle, and in

that case have the bony tissue of a much more spongy texture, as is the case with the ox genus. It is impossible to convey a better idea of these horny but very variously formed cases than by saying that they stand in the same relation to the bony core as the hoof to the last phalanx of the toe. A thick and highly vascular coat forming a continuation of the skin covers the bone, and is nourished by its vessels; and the hollow case or envelope is composed of fused horny fibres formed from fluids which exude from this vascular coat. The growth of the horny case goes on throughout life, but with less rapidity in advanced age, and with numerous interruptions, which betray themselves by the presence of rings and knobs.

Diverse as the Cavicornia are in external form, they yet agree so closely in their general structure that the dividing up of this numerous group into families becomes very difficult, if not impossible. There are many forms in which the horns belong only to the males, but frequently there are closely-allied species in which both sexes are horned. The dentition is remarkably uniform; the upper incisors and upper canines are altogether wanting, the lower incisors, to the number of eight in all, have very similar forms; the cheek-teeth, always six in number in each half of each jaw, exhibit on the surface of the crown typical half-moon-shaped folds; the three premolars gradually assume the form of the true molars. The forms presented by the teeth may indeed serve to distinguish genera and species, especially through the absence of side-columns in the molars of the large species, but these forms vary within very narrow limits.

The Cavicornia almost always have pretty well developed accessory hoofs; some have tear-pits, others not; but here also there are transitions which render it impossible to fix definite boundaries. Pretty much the same holds good with respect to all the other characters; from the plump forms of the ox genus we pass by gentle gradations to forms the most elegant and graceful, such as those of the gazelles. Though most of the species live in very numerous flocks, there are others which are to be met with only in pairs; some are stationary in their abode, others on the contrary undertake great migrations; some prefer moist places, morasses, and the banks of running and standing waters, others the dry and withered plains, others again the steep slopes of the mountains; the Tropics are not too hot for them nor the Arctic regions too cold.

The Cavicornia are usually broken up into sub-families or groups, which are designated by the names antelopes, goats, sheep, and oxen. But in order to avoid mistake, we

must repeatedly insist on the fact, that these subdivisions have no sharp lines of demarcation, that on all sides we meet with transitional forms, with respect to which doubts might be raised as to the group to which they ought to be referred, so that we must consider these groups only as aids which help us to connect the less clearly defined forms with well-characterized types.

The Antelopes.

The antelopes (Antilopida) are a collector's group, if I may so express myself. They cannot be characterized zoologically. They exhibit the most various forms. Certain antelopes can scarcely be distinguished from oxen, others resemble goats or sheep. There is not a single character common to all the animals so called. We accordingly renounce the idea of characterizing them in any other way than in the words of Pallas, who said, naturalists have given the name of antelopes to those ruminants with hollow horns which cannot, without violence, be grouped with the oxen, the goats, or the sheep.

We have already pointed out in the opening remarks on the ruminants that a connecting link between the deer and the hollow-horned ruminants exists in the **Pronghorn Antelope** (*Antilocapra americana*), fig. 164, which inhabits the broad plains on both sides of the Rocky Mountains from Mexico as far as the 53d degree of northern latitude. The horns are without doubt constructed on the type of those of the Cavicornia; they have a solid bony core and a horny case of little thickness. In the young animals these horns are simple prongs. These first horns are often changed, and the change takes place not by the shedding of the bony core as in the deer, but by the growth of a new horny case, which gradually raises and finally thrusts off the old one. When the horns have acquired their permanent form they are no longer shed, and then they are forked pretty much in the same manner as those of the



To face page 88.

PLATE XXVIII. — THE CHAMOIS (*Capella rupicapra*).

muntjac, but are broad and flattened, elegantly curved inwards, and provided with a short prong directed forwards and another ending in a hook directed backwards. The pronghorn antelope is the only member of the Cavicornia with a branched horn; in all the others the horns, whatever their form may be otherwise, are simple. In this case, accordingly, we must recognize an approximation to the deer family. As regards the rest of its organization, the pronghorn antelope may be described as an antelope of about the size of a small fallow-deer, with an expressive head, which, on account of its long ears, resembles that of a stag. The neck is somewhat long and rounded, the body slender, the tail short, like that of the deer; the slim and rather long legs carry only two narrow and pointed hoofs. The accessory hoofs are entirely absent as in the giraffes. The hair is thick and wavy, but brittle. The general colour is a fine isabel-gray, which becomes darker on the back, round the eyes, round the large tear-glands, as well as upon the nose; the belly, the speculum on the back of the thighs, the upper part of the head, and the cheeks are white; a few white spots are also to be seen in front of the neck and breast. The horns of the female are less developed than those of the male.

This beautiful animal traverses the prairies of its native land in great herds under the lead of an old male. The hunters are unanimous concerning the grace of its rapid movements, its extraordinary fleetness, its wonderful leaps; as special characteristics they mention its remarkable shyness and the courage with which it defends its young against the prairie-wolves (coyotes). When caught young these antelopes may easily be tamed in their native land, but they do not survive long in our gardens, which cannot afford them the room necessary for their movements. The pronghorn is the only American species of antelope, all the others without exception belong to the Old World. Since there are no scientific

characters to distinguish them we group them according to the form of their horns and their size.

The sole representative of the antelopes in Western Europe is the **Chamois** (*Capella rupicapra* (*Rupicapra tragus*)), Pl. XXVIII. It is a characteristic animal of our high mountain chains, and ranges from the Pyrenees, the Abruzzi, and the Balkans, through the Alps and the Carpathians as far as the Caucasus and Georgia. There are geographical and localized varieties. The "isard" of the Pyrenees is smaller than the others and is of a reddish colour; the "achi" of the Caucasus has a slightly peculiar curve of the horns, but at bottom it is always the same species, a creature of not very elegant form, resembling a beardless goat with a short thick neck and thick knotty legs. The head is small, rather long and pointed; the ears of moderate length, straight and pointed; the eyes large and prominent; the tail short; the broad hoofs divergent, very hard and almost sharp at the outer edge, the accessory hoofs concealed under a tuft of hair. Both sexes, which in all respects, except the somewhat slighter build of the female, are exactly alike, carry horns, which are supported by almost straight solid bony cores, and, rising at first almost perpendicularly, afterwards diverge a little to the side, and finally end in very sharp hooks directed backwards. These horns, at first round and slightly ringed, afterwards become smooth, and at the hook, which is delicately grooved or striated, somewhat compressed. The stiff and coarse hair is longer in winter than in summer. In general it is of a dirty gray colour, in winter darker, in summer lighter. With the exception of a characteristic dark stripe stretching from the root of the ear over the eye to the corner of the mouth, the head is of a lighter colour.

The chamois inhabits the mountains as far as the limit of trees, and sometimes advances beyond it. In winter it often descends pretty

far down into the valleys, while in summer it visits the treeless and stony heights as far as the snow limit. It runs with great rapidity even upon ice-fields and glaciers, exhibits the most wonderful dexterity in climbing among the rocks, taking advantage of the slightest inequalities in the surface of the ground, and makes astonishing leaps with remarkable precision and security. It rests by night and

goes out to graze by day, always in larger or smaller troops under the guidance of an old female, which stations itself on an elevated spot whence it can keep an outlook over the surrounding country so as to be able to give warning of threatening danger by a sharp whistling sound. The scent of the chamois is very keen, the hearing likewise, the sight less highly developed. Curiosity and timidity



Fig. 165.—Gazelles (*Gazella dorcas*). page 93.

are the chief qualities in the disposition of the chamois; the extraordinary adroitness which it displays in the wild mountainous regions which it inhabits saves it from many dangers which its limited intelligence would not enable it to perceive. The chase, the favourite sport of the mountaineers, is rendered difficult only by the nature of the spots which the chamois frequents—spots which are often quite inaccessible to man. Were it not for that it would be scarcely less easy than that of the roe-deer. In the Alps the chamois would have been extirpated long ago had it not been protected by severe laws against hunters. In Switzerland, where the chase is

allowed at certain seasons of the year, the chamois is already a rare animal, while in the Eastern Alps one still may meet with pretty numerous troops in the estates belonging to the great land-owners. The old bucks are quarrelsome and ill-tempered; they live solitary except in the season of heat, when they wage savage battles with their rivals. For the most part the chamois brings forth only one young one at a time. The young animal is very attached to its mother, who leads it about with great care till about the age of six months. It can follow its mother from the first day of its life, and soon exhibits as much cleverness in leaping and climbing

as the adult animals, while it manifests at the same time a great deal of sportiveness.

The chamois can easily be kept in captivity, but it does not live long, and its keepers have only seldom been successful in obtaining offspring. Hybrids between the chamois and the goat have often been met with, but it has never been found possible to cause these hybrids to propagate. I hope I may be permitted to say without offence to the lovers of chamois flesh that I have never myself found it palatable except in the case of young animals. As soon as the chamois becomes pretty well grown its flesh becomes

tough, and this is especially true of old bucks, of the killing of which many a hunter is so proud. The flesh of such an animal has not

only a shockingly bad taste, but also a disagreeable smell.

[“The tenacity of life exhibited by the chamois is very remarkable. Tschudi, author of *Das Thierleben der Alpenwelt*, mentions an instance in which a chamois buck was shot dead, which had previously had one of its horns shot away and one of its legs broken, and which bore the scars of a bullet that had passed through its body. In another case two chamois

were shot over a precipice, and the hunter, in taking up one of them, detected signs of life still remaining in it, and gave it two or



Fig. 166.—The Sassa Antelope (*Oreotragus saltator*). page 93.

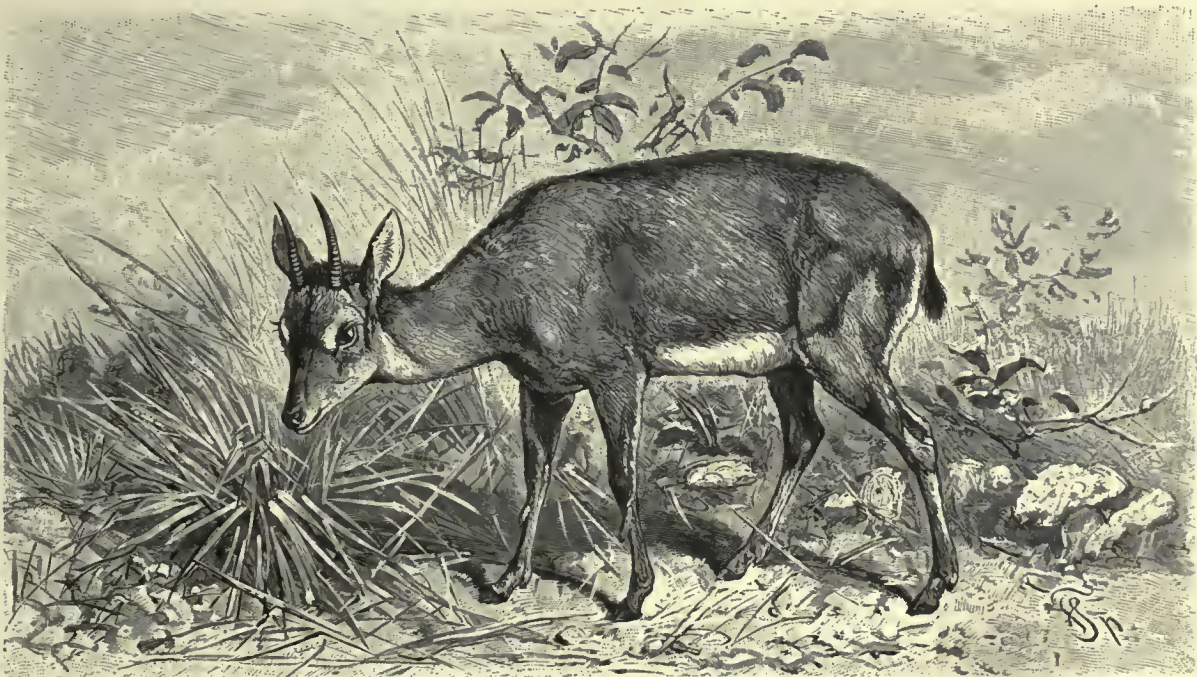


Fig. 167.—The Bleekbok or Urebi (*Calotragus scoparius*). page 93.

three smart blows on the head. This, however, had only the effect of making the animal recover more completely, for though held by one leg it at once bounded off dragging the hunter along with it, till at last it managed to disengage itself by a great

leap, after which it was quickly lost to view. Often the hunter follows an animal that he has struck on what would seem to others quite impracticable steeps, and the most astonishing adventures are recorded of huntsmen, who, in the heat

of the chase, have achieved feats which in cold blood they could not have had the hardihood to contemplate. The following adventure is related, on the authority of Kohl, by the author referred to above. A chamois-hunter in the Bernese Oberland leaped down upon a friable ledge of slate only a foot in breadth running along the face of a precipice about six hundred feet high. When he found the rock crumbling away and threatening to give way altogether beneath his feet he was compelled to lay himself slowly down on the ledge, face downwards, and drag himself cautiously along. With a small axe he broke away the brittle slate in front of him, and crawled on foot by foot, in constant dread of seeing the ledge break entirely away. After labouring on for an hour and a half he observed a shadow fluttering on the face of the rock beside him, and managing with some difficulty to look upwards saw a large eagle circling in the air above, and evidently bent on hurling him down the abyss. He at once began to contrive the means of turning round on his back, and having by dint of great efforts and the exercise of the utmost caution accomplished this, succeeded at the end of another quarter of an hour in bringing his rifle into position for firing. Then resting the back of his head against one small projection in the rock, and twisting one of his legs round another, he lay for a while in that position watching the eagle, which in the end thought it better to fly off and leave the hunter to continue his efforts to crawl along the narrow shelf on which he was hanging on the brink of destruction. Three hours of the most desperate exertions it cost him before he got to the end of the ledge and was able to stand on firm ground with torn clothes and lacerated hands and arms.

"When the hunter has succeeded in overtaking

his game he fills the air with a shout of victory, gives the animal the final thrust, tears out the entrails and throws them away, taking, however, great care of the fat, ties each of the lower legs to the thigh, and then swings his booty, perhaps seventy pounds in weight, by a strap over his back. His comrades follow, and they seldom fail to finish up with a grand carousal. If the leader of the

troop, the 'Führgeiss,' has been slain, the others usually run confusedly round in a circle, not knowing what to do, and fall an easy prey to the hunter.

"The reader will no doubt ask, what is the reward of the risks and hardships that the chamois-hunter has to encounter? He perhaps imagines that the chase of the chamois is, at anyrate, a lucrative occupation. Not so. A Freiburg proverb says that it requires nine chamois-hunters to support one. The dangers and difficulties of the chase itself are almost its sole attraction, but, never-



Fig. 168.—The Duyker-bok or Madocqua (*Cephalophus mergens*). page 94.

theless, they form an attraction so strong that with the true chamois-hunter the love of the sport is no less than an irresistible passion. The following case may seem almost incredible, but can be matched, it is said, by many others. A devotee of the sport had one of his legs amputated, and two years afterwards sent his surgeon out of gratitude half of a chamois that he had shot, remarking that with his wooden leg he could not get along so well as before in the chase, though he hoped to bring down many a chamois yet. At the time of the amputation the man was seventy-one years old. Alongside of this case may be mentioned that of the guide who said to Saussure: 'A short time ago I was very happily married. My grandfather and my father both perished in the chase of the chamois, and I am sure to meet my end in the same way. But if you would make my fortune on condition that I should give up the chase, I could not

accept the offer."—*Switzerland: Its Scenery and People.*]

Next to the chamois we may arrange a large number of elegant animals which have horns of simple form and attain at the most the size of a goat or a roe-deer. In this group the Arabians have always claimed the

first place for the **Gazelle** (*Gazella dorcas*), fig. 165, in which both sexes are adorned with the characteristic black horns with a slight lyre-shaped curve. The large straight ears are rounded at the end. The wonderfully beautiful yellowish-brown eyes are held in as high esteem by the Arab poets as the forget-me-not eyes among those of Germany. The body is slender, the tail short but with a thick tuft, the legs long and very slim. On the elegant little head may be observed tear-pits of no great

size. The colour is a beautiful grayish-yellow on the back, white underneath, a darker stripe separates these two colours.

The home of the gazelle extends from the mimosa-clad steppes and deserts of Nubia and Kordofan to Arabia on the east, and to Morocco on the west. The colour of its coat conceals it perfectly in the midst of the stones. The flocks pasture by day under the leadership of an old female. In some cases the young are rather weak on the legs for several days after birth, so that they easily fall a prey to wild animals or to man. The flesh is good to eat, and the chase is carried on by all methods—by means of the cheetah, by means of falcons, with dogs, or

with fire-arms. The gazelle has a keen scent and acute hearing, but is not very intelligent. It is often met with in the East as a domestic animal; gentle and even docile as a rule, it is yet subject to accesses of fury, during which it may become dangerous to children.

In the high mountains of the Cape region,

of Sennar, and Abyssinia, the **Sassa** of the Abyssinians (*Oreotragus saltator*), fig. 166, takes the place of our chamois, which it quite equals in adroitness and facility of movement. The male alone carries small, almost straight horns, with the points bent a little forwards. The head is small and short, the legs thick, the tail rudimentary, the hoofs sharp at the edge. Tear-pits are present. The colour is a light olive-green marbled with white. The animal lives in pairs or in families, shows much attachment



Fig. 169.—The Four-horned Antelope (*Tetracerus quadricornis*). p. 94.

to its chosen seats, and is eagerly hunted on account of its excellent flesh.

The **Bleekbok** (pale-buck) of the Boers, the **Urebi** of the natives (*Calotragus scoparius*), fig. 167, is also met with at the Cape. It lives in pairs, and prefers the steppes with tall grasses. The horns of the male, somewhat stronger than those of the previous species, are similar in form; the tear-pits are tolerably large. This pretty antelope is of about the size of a roe-deer. It is reddish or cinnamon-brown on the back, white underneath, with white spots round the eyes and on the lips and chin. On the knees there are long tufts of hair. Notwithstanding its agility and the extraordinary leaps which it

makes this game easily becomes the prey of the hunter, who takes advantage of its stupidity.

The **Duyker-bok** or **Madocqua** (*Cephalophus mergens*), fig. 168, is distinguished by the short and straight horns of the male, which are almost hidden by a tuft of hair and by the very large pointed ears. The legs are very thin, the tail short and provided with a

terminal tuft. The colour varies very much from gray to olive-green. The animal frequents moist places in the denser parts of the bush, and shows great skill in taking advantage of the shelters afforded by its retreat to hide itself from pursuit; hence the name, meaning "ducker," bestowed upon it by the Boers. It takes a zigzag course in running. Its flesh is tough, but the leather



Fig. 170.—The Rietbok (*Reduncus eleotragus*).

made from its hide is highly esteemed as a material for whip-cords.

The **Chikara** of India, the **Four-horned Antelope** (*Tetraceros quadricornis*), fig. 169, an animal of about the size of a gazelle, is easily distinguished by the possession of a second pair of small horns above the eyes, while the principal horns, which are almost straight and not very large, are set between the ears. The ears are large, the tear-pits rather long, the nose broad and naked, the legs long and slender. The male alone carries horns. The animal inhabits the wooded mountainous regions of Bengal and Nepaul. In captivity it shows boldness and ill-temper.

The **Rietbok** (reed-buck) of the Boers, the **Umseke** of the natives (*Reduncus eleotragus*), fig. 170, is a little larger than our roe, and at the same time a little more slender and higher on the legs. The very sharp horns of the male are curved forwards, the ears long, the neck long and round, the tail comparatively long and bushy, the fur rather short but thick, of a reddish-gray colour, lighter underneath. The animal lives in pairs in the dense thickets of Central and Southern Africa. When hunted it allows its pursuer to approach pretty close up to it, concealing itself meanwhile carefully. On perceiving signs of danger it gives warning

to its comrades by means of a kind of | detested by the Kaffirs and Namaquas on
sneezing, as many antelopes do; and it is | account of the devastation which it works



Fig. 171.—The Harnessed Antelope or Guib (*Tragelaphus scriptus*).

in their fields. It is very tenacious of life. |
Its flesh is highly esteemed.

The Harnessed Antelope, the Guib (*Tragelaphus scriptus*), fig. 171, an animal of the



Fig. 172.—The Saiga Antelope (*Colus tartaricus*). page 96.

size of a fallow-deer, a native of Abyssinia | for the bright colours of its coat. The head,
and the whole of West Africa, is remarkable | the neck, the breast, and the back are of a

brownish-gray colour; the sides and the thighs of a rusty red, and upon these parts there are white spots and stripes, of the arrangement of which the illustration will give a better idea than a long description. The horns of the male are thick, flattened, and

provided with two keels or ridges, which meet at the extremity of the horn. The two horns have an elegant curve inwards. This beautiful animal lives in pairs in the forests; it is easily tamed, stands our climate pretty well, and on account of its gentleness



Fig. 173.—The Nylgau (*Portax pictus*).

and easiness of management has become one of the favourites as well as one of the most frequent ornaments of our zoological gardens.

The Saiga (*Colus tartaricus* (*Saiga tartarica*)), fig. 172, is the only European antelope besides the chamois. Its domain formerly extended as far as the foot of the Pyrenees; but at the present day it is confined to the steppes of Russia, from the frontiers of Poland to the Altai Mountains. It is a rather abnormal type, with a sturdy massive body and short legs, and is specially distinguished by the peculiar form of

its nose and upper lip, which are swollen and wrinkled, the lip hanging down over the mouth like a short but very mobile proboscis. The horns of the male are short, curved slightly in the form of a lyre, almost transparent. The animal possesses a large number of skin-glands, which exude fragrant oily fluids. Besides the very deep tear-pits there are glands in the region of the groin. The fur, gray on the back and the flanks, whitish on the abdomen and brow, is almost like the fleece of a sheep. The animal lives in troops, which are often very numerous, is very timid but easily tired out when pursued, and in

spite of its keen scent easily becomes the prey of the hunter. The flesh is made disagreeable by the smell of musk imparted to it by the superficial glands. The saiga is often seen in zoological gardens, where it frequently perishes through its own stupidity, breaking its neck or its legs by dashing against the bars of its cage.

The Nylgau (*Portax pictus* (*Boselaphus tragocamelus*)), fig. 173, forms the transition to the powerful and clumsy species which are higher at the shoulders than behind, the reverse being the case with the slighter and more elegant forms of which we have just been treating. The nylgau, which inhabits principally the edge of the jungles in the



Fig. 174.—The Sing-Sing or Waterbok (*Kobus ellipsiprymnus*). page 98.

East Indies, is often imported into Europe, where one can make its acquaintance in the zoological gardens. It is of the size of a stag, is on the whole ill-proportioned and inelegant, has a rather shaggy coat, and appears to be decidedly weak in the loins. The small longish head is often furnished in both sexes, most commonly, however, only in the male, with short, pointed, slightly curved horns. The ears are large, the eyes small and lively but malicious, the tear-pits deep. On the breast is a slight dewlap. The shoulders are very high and angular, the back slopes rapidly towards the hinder extremity, the tail is pretty

long and bushy, the feet strong and provided with broad hoofs and flattened accessory hoofs. The hair is rough and coarse; it forms a sort of mane at the neck and shoulders, and there is a long tuft about the middle of the neck in front as well as at the end of the tail. The general colour is a grayish-brown with blue reflex colours, which have procured for the nylgau the name of the "blue ox." Besides a few white spots on the lips, the throat, and under the tail, the nylgau is specially distinguished by two white rings on the feet, one immediately below, the other above the accessory hoofs. The nylgau

is much hunted on account of its excellent flesh as well as on account of its hide, which makes a very flexible leather. When wounded it attacks the hunter, throwing itself upon its knees and creeping up to him. In captivity it is ill-tempered and often attacks its keepers. Since 1860 the King of Italy has possessed

a pretty large herd of nyлгаus at San Rossore, near Pisa, where the animals appear to thrive.

The **Sing-Sing**, the Waterbok of the Boers (*Kobus ellipsiprymnus*), fig. 174, has the appearance of a large fallow-deer and almost attains the size of our stag. The horns of



Fig. 175.—The Sable Antelope or Swarte-bok (*Hippotragus niger*).

the male are large, curved in the shape of a lyre, ringed for two-thirds of their length, the ears of moderate size, the eyes pretty large. The hair is rough but oily-looking and shining, somewhat longer at the neck than in other parts, and there is a tuft at the end of the tail. The legs are slender. The waterbok lives in small herds under the leadership of an old male, and inhabits the marshes of Central Africa and the Cape region. It always remains in the vicinity of water, into which it plunges when danger threatens, in order to save itself by swimming. The flesh of adult animals smells strongly of musk; that of the young alone is eatable.

The **Sable Antelope** or Swarte-bok (*Hippotragus niger*), fig. 175, is of about the size of a stout short stag. The male carries long horns curved backwards and ringed to the points like those of a goat. The horns of the female have the same form but are smaller. The head is small and short, the ears long like those of an ass, the tail of moderate length, very thin and with a large terminal tuft. A long loose mane runs from the nape of the neck to the middle of the back, and there is a shorter one on the under surface of the neck. The colour is a brilliant black; a broad white stripe extends from the eye to the lips and here unites with another



To face page 98.

PLATE XXIX. — THE CANNA OR ELAND (*Bucelaphus canna*).

white chin-stripe. The under side of the breast and the belly, as well as the inner sides of the legs, are white. Formerly this animal was considered to be a blauw-bok (*H. leucophaea*) in its summer dress, but it has now been ascertained to be an inde-

pendent though rare species. Blauw-boks and swarte-boks live in troops under the leadership of an old male in the rocky and mountainous parts of Central Africa. In the Cape region they are almost extirpated. They are extremely shy and timid, darting off on



Fig. 176.—The Leucoryx or Sabre Antelope (*Oryx leucoryx*).

the least hint of danger. The flesh has an abominable taste like that of a he-goat.

The **Spietboks** (*Oryx*) are large African antelopes, heavy-looking and clumsy in form. They are of about the size of a stag, and are distinguished by their enormous horns, which are usually as long as the body. They are straight or very slightly curved, thin, pointed, plainly ringed, and are developed in both sexes. The head and the tail resemble those of the cow, of which the short and massive neck also remind us, especially since it often carries a slight dewlap. The species represented in fig. 176, the **Leucoryx** or Sabre Antelope (*O. leucoryx*), is found in the deserts

of Central Africa, especially in Sennar, and it advances up to the Egyptian frontier. Formerly its domain extended further to the north, as is shown by the numerous figures seen on the ancient monuments. These beautiful animals wander about in small troops in the dry steppes, and in spite of their apparent clumsiness rival the best horses in running. Bold and defiant, they make a stand against both beasts of prey and hunters, endeavouring to transfix their assailants with their horns. Where they have made acquaintance with fire-arms, however, they flee before the hunter, whom they scent at a great distance. The species represented is whitish-yellow

above, white underneath, and marked with brown spots on the head. It is often seen in zoological gardens.

The **Canna** of the Kaffirs, the **Elen** of the Boers (*Busclaphus orcas*), Pl. XXIX., is the heaviest of all the antelopes, and that

which has most resemblance to the oxen, and especially to the zebu. This resemblance is so great that at a distance, when the horns cannot be distinguished, one is in doubt whether a herd grazing in the steppes consists of cannas or zebus. The neck adorned



Fig. 177.—The Mendes Antelope (*Addax nasomaculatus*).

with a large pendent dewlap, the short sturdy limbs, the pretty long tail with a large terminal tuft, the absence of tear-pits, the presence of a hump on the shoulders, the brownish-yellow colour, with the white spots on the head and neck, the habits, the gait—everything reminds us of the humped oxen. The horns, however, are very different. They are straight, of moderate length, continue the line of the brow, and have a large thick keel or ridge wound round them spirally to the extremity. A strong bull of this species may reach the weight of a ton. The canna is now found only in Inner Africa between the equator and the Tropic of Cancer, but

its domain formerly extended to the Cape region, where, at the time when the settlers arrived, troops of several hundred head used to pasture. Mounted hunters endeavour to overtake the old bulls, which cannot hold out very long in running. Descendants of a pair of cannas which the Earl of Derby introduced in 1840 are now found in almost all zoological gardens, where they behave like cattle. The flesh is very savoury, that of the young animal tender, while that of the old bulls has a disagreeable odour like the flesh of a he-goat.

The **Mendes Antelope**,¹ the Abbu Addas of

¹ Supposed to be the pygarg of Deut. xiv. 5.—Tr.

the Arabs (*Addax nasomaculatus*), fig. 177, is found in the eastern Sahara and as far east as Nubia, usually in pretty large flocks. This antelope, which is more eagerly hunted than any other by the nomads with their slughis or Arabian greyhounds, is indeed less clumsy-looking than the canna, but yet resem-

bles the oxen pretty closely in the plumpness of the body, the thickness of the legs, and the general appearance of the tail, which is long and has a large terminal tuft. The horns, which are found on both sexes, are straight from base to tip, but have a double spiral twist round their axis, and for two-thirds of



Fig. 178.—The Caama or Hartebeest (*Bubalis Caama*).

their length up are surrounded by numerous oblique rings. These horns served as an ornament for the head in many of the deities of the ancient Egyptians. The head, the neck, and the short mane are brown, the rest of the body whitish-yellow. A white transverse stripe is always to be seen on the nose. Regions of drought are the favourite abode of the addax. It is a swift runner, and defends itself with courage against dogs when wounded. In captivity it is ill-tempered and liable to accesses of fury.

The Koodoo (*Strepsiceros kudu*), of which there is a full-page illustration (Pl. XXX.), has long flattened horns, indistinctly ringed

and with a marked spiral twist. The size, the appearance, and the habits of this beautiful antelope remind us of our stags. It frequents the forests and the bush of the whole of the interior of Africa from the Cape to the borders of Sahara, lives like our stag, and is used and hunted like it. The general colour is a reddish or brownish gray, but there are irregular white spots on the flanks. The mane and the tail-tuft are blackish, the long hair on the dewlap gray, the legs and the middle of the forehead white.

The Caama of the Kaffirs, the Hartebeest of the Cape Colonists (*Bubalis (Alcelaphus) Caama*), fig. 178, which is also of about the

size of a stag, is distinguished by its longish head and its short stout horns, which meet at the base, are markedly ringed and curved in the form of a lyre. Recently naturalists have distinguished several species which approach very close to the hartebeest, and are, perhaps, only local varieties. The species shown in fig. 178 is cinnamon-brown, the forehead, the front of the legs, and the bushy

tail are black, narrow rings round the eyes, the inner side of the thighs and the speculum are white. The hartebeest was formerly very abundant near the Cape, but has been almost extirpated there by the ceaseless persecution to which it has been exposed on the part of hunters. It is still found in Inner Africa, in the land of the Bogos and the Niam-niam, and is generally to be seen on the banks of



Fig. 179.—The Indian Antelope (*Antelope cervicapra*).

rivers in herds of about twenty individuals. It is a rather quarrelsome animal, but may to a certain extent be tamed, though it sometimes becomes dangerous.

We have reserved till now a singular antelope belonging to India, and known as the **Indian Antelope**, though called by the Hindus themselves the Sassi (*Antelope cervicapra*), fig. 179. Its long, ringed and spirally twisted, but straight horns remind us of the addax, but in other respects it has rather the appearance of a gazelle. The animal is revered by the Hindus, who have placed it in the zodiac in place of the ibex (Capricorn), and regard it as sacred to Chandra, the goddess of the moon. The male, which alone is horned, is of a dark grayish-brown colour,

the female lighter; the belly, the inner side of the legs, the speculum, the lips, the ears, and the rings round the eyes are white. The legs are thin, the tail short and provided with a terminal tuft, and tufts of hair adorn the knees. The tear-pits and inguinal glands are remarkably large, and filled with an oily ill-smelling secretion. The animal lives in open woods and groves in pretty numerous troops led by an old male. The great nobles of Bengal hunt it with falcons or greyhounds.

The **Gnus** (*Catoblepas* (*Connochætes*)) present a union of rather singular characters, which may always be observed in our menageries and zoological gardens. Two species are known, both natives of the Cape; of



To face page 102.

PLATE XXX. — THE KOODOO (*Strepsiceros kudu*).

these the one shown in fig. 180, the **Wildebeest** of the colonists (*C. gnu*), is the commonest. The head resembles in a measure that of a small buffalo; the horns, which are placed near one another and are present in both sexes, are twisted first outwards and downwards and then upwards and forwards,

and finally end in sharp points. The ears are of moderate size, there is a tuft of stiff hairs on the nose, another on the throat; a short stiff mane similar to that of the zebras runs along the neck from the nape to the shoulders. Tufts of hair also hang from the breast, and the tail, which is moderately long,



Fig. 180.—The Wildebeest or White-tailed Gnu (*Catoblepas gnu*).

is bushy. The body is pretty long, the legs strong and of moderate length, the hoofs broad and high. The nostrils can be completely closed; the small eyes have an expression of wild savagery. The general colour is a dark brownish-gray; the eyebrows and the hair on the lips are white. The animal is of about the size of an ass. Large flocks of it inhabit the plains of Africa south of the equator. From all other antelopes it is distinguished by its alternately roguish and frolicsome, but frequently also sullen and savage disposition. The colonists were right when they bestowed upon it the name of "wild cattle." It is now often seen in our menageries, but its outbursts of fury always make it dangerous to its keepers.

The Goats.

The group of the goats (*Caprida*) is distinguished by the structure of the horns. These have solid bony cores, and the horny sheath is bent backwards and laterally compressed, so as to form an edge, and has knobs or tubercles arranged transversely in the form of rings. Both sexes carry horns, but those of the female are always smaller than those of the male, and are like those of the young he-goats. The goats almost always have a beard at the chin. They have neither tear-pits nor inguinal or interdigital glands. The short tail with two lines of hairs and naked on the under surface is usually carried erect. The large hard hoofs

are almost sharp on the outer edge, and when seen in profile have the form of a rhomboid. The hair is sometimes coarse, sometimes fine and silky, but it does not present the character of true wool. The straight nose distinguishes the goat from the ram's-nose of the sheep. But it must be confessed that there are transitional forms between these two groups, as well as between antelopes and goats, the connecting links being the chamois on the one side and the Rocky Mountain goat on the other.

The goats inhabit high and steep unwooded mountains, where they can climb about to their heart's content, scorning the dangers presented by the chasms and precipices. They are not fond of woods, but delight to graze among shrubs and dwarfed and creeping trees, where they find aromatic herbs in abundance. They run, climb, and spring with wonderful dexterity; the smallest point of support serves to enable them to make a leap or to take foothold. The ibex



Fig. 181.—The Rocky Mountain Goat (*Haploceros americanus*).

surpasses even the chamois in the certainty with which it estimates distances for extraordinary leaps. The senses, especially those of smell and sight, are extremely well developed. The goats are very capricious in the choice of plants on which to feed; they are roguish and fond of teasing, cunning in case of need, bold in presence of danger, if they cannot escape from it by rapid flight. The old males become ill-tempered and even dangerous to man. The old females take charge of the herd in turn while it is grazing or resting. The young goats are delightful

on account of their graceful movements and comical attitudes. They can follow their mothers a few hours after birth. All goats have that peculiar smell which is so well known, and which is present even in the flesh, which on that account is less highly esteemed than that of the sheep. The hunting of goats is always laborious and exhausting, and often likewise dangerous on account of the nature of the resorts where they are found.

The American Rocky Mountain Goat (*Haploceros americanus*), fig. 181, inhabits the heights of the mountains from which it is

named as far as the 65th parallel of northern latitude. It is a wonderfully beautiful animal, of the size of a goat, but with more thickset body, stronger legs, and this appearance is

still further enhanced by the long thick white coat of hair by which it is completely covered. Only the borders of the nose and lips besides the hoofs are naked. This beautiful coat



Fig. 182.—The Markhor (*Capra falconeri*). page 106.

consists of a thick close-set down and of stiffer hairs, which become longer on the back so as to form a thick erect mane, extending from between the horns along the middle line of the back to the root of the tail. The pretty thick beard rather forms whiskers than a true goat's beard. The down is not wool composed of flattened and spirally twisted hair, but is, on the contrary, made up of very thin, long, and perfectly cylindrical hairs. The animal undoubtedly shows a

tendency to approach the antelopes in the character of its horns, which are round, without edges or tubercles, and feebly ringed at the base, yet the terminal hook is not so well marked as in the chamois. Besides, the tail is not that of a goat. It is covered with hair all round, and, instead of being carried erect, bends down between the legs. These goats may, therefore, be ranked as a separate genus, approaching more closely to the antelopes than others, but belonging to the goats in

respect of the rest of their organization. The Rocky Mountain goat frequents the highest naked peaks of its home, between the limit of forests and the snow-line, and among the few hunters of those sparsely inhabited regions enjoys the same reputation as the chamois with us. Its flesh is very bad.

The Markhor of the natives of the East Indies (*Capra falconeri (megaceros)*), fig. 182, is a powerful animal, much stronger than the domestic goat. It is distinguished by the strongly keeled horns of the male, which are twisted like a cork-screw, and are very similar to those of the koodoo antelope; the horns



Fig. 183. —The Grecian Ibex (*Capra aegagrus*).

of the female are much smaller and less twisted. It also has the skin pretty uniformly covered with hair, while in the adult male the beard is prolonged into a kind of mane which envelops the neck and breast, and gets lengthened on the shoulders and back into a shaggy fur. This mane is a little lighter than the rest of the fur, which has a dark grayish-brown colour on the hinder parts and the front of the legs, while the under surface and the inner side of the legs are again somewhat lighter. The markhor lives on the high peaks of the Himalayas of Tibet, in Kashmir and Afghanistan, and the hunters maintain that it devours serpents. Specimens of this goat have been brought to Europe, where it has been tamed to a certain

degree, but has always remained somewhat capricious.

The Grecian Ibex or Bezoar goat, the Pasong of the Persians (*Capra aegagrus*), fig. 183, is manifestly the wild goat which Homer mentions when he speaks of the islands of the Cyclops and Crete. Even at the present day its domain extends from the islands of the Archipelago to Persia. The strongly curved horns of the male exhibit about a dozen knobs or tubercles in front, those of the female are simply compressed. The beard is very strong. The usual colour of the hair is reddish-brown; the under surface and the inner side of the legs are whitish; the patch on the brow, the tail, and a longitudinal stripe on the back are black. On the shoulders

also darker stripes can be distinguished, as well as on the under parts of the flanks and the legs. Formerly these goats were much hunted in Asia Minor, because peculiar medicinal virtues were ascribed to the round swellings which are formed in the stomach of these as well as many other ruminants, and which are known as bezoar balls.

Here the question of the origin of the Domestic Goat (*Capra hircus*) is forced upon us, a question which, as in the case of all other animals domesticated at a remote period, is complicated by the number of varieties, the mingling of species, and the influence of man. In the first place it is incontestable that the wild goats already



Fig. 184.—The Angora Goat (*Capra hircus*, var. *angorensis*). page 108.

mentioned and figured, as well as many others, all originally belonging to Asia, which have not been figured in this work, are capable of producing fertile hybrids with our domestic goat. On the other hand, it is equally incontestable that goats belong to the oldest of domestic animals, that their remains have been found in the neighbourhood of lake-dwellings, that among the ancient Egyptians at least two, if not more, easily recognizable races were represented, and that at the present day we know at least a dozen different races distributed over all countries of the world. Yet we are now acquainted with not a single wild goat either in Western or Central Europe, or in Africa, with the sole exception of the ibex, which is essentially different in the struc-

ture of its horns from the domesticated breeds. It is accordingly probable that the goats were introduced into Egypt and the lake-dwellings. The two species represented in this work are so like certain domesticated races that we must allow that they have contributed to their formation, which does not exclude the possibility that other species also have co-operated with these towards the same end. But whatever the truth may be as regards this matter, it is at least certain that goats easily revert to the wild condition, just as wild goats are very easily tamed.

But it is not our business to discuss the tame races which have been formed by the influence of man. We take, however, this opportunity of expressing our opinion of the

utility of these animals. If, on the one hand, it is unquestionable that the goat must be called on account of its milk the cow of the poor, that it yields, especially in countries where cattle and sheep do not thrive very well, an important element of food, that the skins are of the highest value, and that certain races, such as the Kashmir and the Angora Goat (*Capra hircus*, var. *angorensis*), fig. 184, have been brought, in certain mountainous countries with a raw climate, by careful in-and-in breeding, to produce an invaluable kind of long wool, which envelops almost the entire body of the animal, and is unsur-

passed for delicacy and softness; yet it must be confessed, on the other hand, that the goat is the most destructive creature in the world in forests, and that the old seats of civilization, namely the countries round the Mediterranean, owe the destruction of their forests, the nakedness of their mountains, and the inevitable consequence of that condition, the dryness of their climate, to the devastations of these animals. Man destroys

the forests when full-grown in order to procure the timber, the goat prevents their being renewed. It devours the young plants as they spring up out of the ground and the

young shoots on the trees; wherever the goat comes it makes the work of re-afforestation an impossibility. It is not without reason that a German legend ascribes the creation of the goat to the devil. The evil spirit is said to have bestowed upon it its horns, its eyes, and its beard, and to have bitten its tail short because it got caught by it in the underworld. Its influence in lands deprived of trees has been perni-

cious enough to justify such a legend.

The Ibex.

The **Bouquetins**, the steinbocks of German Switzerland (Ibex), are distinguished from the goats proper by the enormous size of their horns. These are triangular in section; in front they are broad, and on that side there is on each horn a series of transverse ridges. In other respects they are goats.



Fig. 185.—The Alpine Ibex (*Ibex alpinus*). page 109.

Every chain of lofty mountains in Europe and Western Asia has its own species of ibex. The Alps, the Sierra Nevada, the Caucasus, the Altai Mountains, Mount Sinai, and the mountains of Abyssinia have ibexes which are somewhat different from each other as regards their horns and skins, but are similar to one another in the rest of their structure and their mode of life. They are all animals which dwell in the highest regions and exhibit all the qualities of goats in the highest degree. We have not considered it necessary to repeat here what has already been said, and we only add a few words concerning the **Alpine Ibex** (*Ibex alpinus* (*Capra ibex*)), fig. 185, which has no beard, and simply curved, and slightly divergent horns with very prominent ridges or knobs.

This majestic animal, formerly distributed over the whole Alps, had already in the middle ages become rare, thanks to the unceasing pursuit of which it was the object, in consequence of a fancy which ascribed all sorts of medicinal virtues to different parts of the animal. Even at the present day the fat and the dried blood of the ibex are sold in certain Alpine valleys at high prices. The horns, likewise, had a considerable value, and the labours, privations, and dangers connected with the chase of the ibex on the almost inaccessible peaks where it had to be followed, were among the highest enjoyments of sport. Now the ibex exists only in a few districts of the Alps, where it is protected in the strictest manner. From the Swiss Alps it has entirely disappeared, and in the western Alps it is still found only in the Val de Cogne and the ravines opening into it, which King Victor Emmanuel placed under strict supervision. On the summit of the Col de Géant, between Chamounix and Courmayeur, there is to be seen at the height of ten thousand feet a board with the inscription, "Defense de chasser," and keepers are placed all round. There are perhaps in this district still about three hundred head in all, distributed in

small troops of about a dozen each. Attempts have been made without success to re-introduce the ibex into the Austrian Alps. In the zoological gardens at Schönbrunn and a few others elsewhere are kept a number of ibexes, which excite general astonishment by their enormous leaps. They are capable of being tamed to a certain degree, but in old age they become ill-tempered. Hybrids between the ibex and the common goat have also been reared, but all of these became in advanced years so ill-tempered and unmanageable that they had to be killed. The descendants of these hybrids acquired in course of time the characters of common goats.

The Sheep.

The sheep are distinguished from the goats by their flat brow, the ram's nose, the absence of the beard, and the presence of tear-pits and interdigital glands, as well as by the character of their horns, which are twisted like the shell of a snail, and adorned with rings of knobs or tubercles. These rings are continued on the three or four sides of the horns. The legs are thinner and longer than those of the goats, the body more slender, and the tail shorter and covered with hair all round. This covering is made up of a thick wool mixed with longer fine hairs. But, as already mentioned, there are connecting links between the two groups, for example, goats without any beard and with interdigital glands and small tear-pits, and, on the other hand, sheep with a straight nose and without tear-pits. In the sheep both sexes are provided with horns, but those of the female are always smaller than those of the male, and also, for the most part, less twisted.

The mode of life of wild sheep is absolutely the same as that of goats. But for us, who only know the tame animal, rendered stupid by slavery, the sheep is the type of dull submissiveness, of peace-loving indolence and blind obedience, without will, without vivacity,

and without individuality. Further, we know sheep only as numbers of a herd which acts in a mass under the direction of a foreign will, blindly following the movements of whatever leader happens to be selected, whether a male of their own species, a dog,

or a man. The wild sheep is quite different from this; it is intelligent, when young full of spirit and sportiveness, when full-grown courageous. It climbs and leaps well, and is an untiring runner; no mountain slope is too steep for it, no peak inaccessible. As in-



Fig. 186.—The Barbary Wild Sheep or Arni (*Ovis tragelaphus*).

habitants of the lofty naked parts of mountain chains, the sheep behave altogether like goats, except that in them the social tendencies are more highly developed, since they very readily collect into considerable troops, and are easily led by their watchful and careful leaders. They likewise become very easily attached to man; yet, while other animals have advanced in the development of their capacities by association with man, the sheep, cattle, and to a certain extent also goats, have in that way lost their intellectual and individual qualities, inasmuch as they have become in the hands of their master merely means for the production of flesh, milk, and wool.

The Barbary Wild Sheep, the Arni of the

Arabs (*Ovis tragelaphus*), fig. 186, is an essentially African type, characteristic of the high chains on the south of the Mediterranean. It approaches most nearly to the ibex in respect of its straight forehead, thick-set body, thick and simply curved horns, with numerous but only slightly prominent rings, and by the absence of tear-pits. It possesses, however, interdigital glands. It is a large animal, which is found only in the most desolate tracts of the Atlas and the Aures, where it is hunted with infinite labour and even danger, for the old males, which attain a height of upwards of three feet at the shoulders, will attack man without hesitation. The male is distinguished by the possession of very long hair in front, where it hangs down to the

ground. This appendage begins with the beard, and is particularly well developed on the breast and fore-feet, and it gives to the animal a peculiar appearance. In the female this hair is considerably shorter, and reaches only to the knee. The tail is pretty long, and carries a long tuft of hair at the end, the

hairs being set very thick on both sides. The colour of the coarse and shaggy fleece is a bright reddish yellow, and admirably adapted to the rocks, in the midst of which it lives in small herds. The arni has been brought to Europe, where it propagates itself very readily in zoological gardens. The old



Fig. 187.—The Rocky Mountain Sheep or Big-horn (*Ovis montana*).

males, however, become very ill-tempered, and often attack with fury some part of their cage, which they try to break through by butting with their horns.

The **Rocky Mountain Sheep**, the **Big-horn** of the Americans (*Ovis montana*), fig. 187, attains even a greater size than the arni. The body is more slender, the legs are longer and thicker, the profile of the forehead is likewise straight, as in the latter animal; but the horns of the male are thicker and very broad in front; they have more of a spiral twist than in the arni, and end in blunt points directed outwards. The rings on the horns are very close-set. The horns of the female, however, resemble those of an ordinary goat. An adult male may attain the weight of nearly

four hundred pounds. The hair is short, erect, and soft; its usual colour a grayish-brown, darker on the back. The under surface, the inner side of the legs, and a patch on the hinder quarters are white; the tail is short, and ends in a blackish point or tuft of hair. The big-horn climbs and leaps in the most wonderful manner. It inhabits the desert tracts on the western slopes of the Rocky Mountains between the 40th and 68th degrees of northern latitude. A living specimen has never been obtained. A mouflon belonging to Kamchatka, the Kurile and Aleutian Islands (*O. nivalis*) has been described, but it is probably only a slightly different variety of the big-horn.

The **Kashkar** of the Kirghiz (*Ovis Polii*),

fig. 188, inhabits the high plateaux of the Pamir in the east of Bokhara, and probably extends to Tibet. This splendid animal has been figured as a representative of a pretty considerable number of sheep inhabiting Central Asia, among which the *Argali* (*Ovis Argali*) is the best known, and the largest, for it attains the size of a moderately large

stag. The kashkar, which, according to Wood, is of about the size of a two-year old foal, and attains the weight of about five hundred pounds, has had its Latin specific name bestowed upon it in honour of the celebrated traveller Poli, who was the first to describe it. The horns of the male are very large, bent round in a circle with the ends



Fig. 188. —The Kashkar (*Ovis Poli*).

turned outwards, and very broad in front; the two side faces form at their junction a sharp cutting edge. The ringed structure is very marked, and the rings themselves lie very close together. The female has horns resembling those of a goat, and also closely ringed. The profile of the head is slightly curved, the body rather long, the legs long and tolerably slim, and the tail quite short. The back and sides are usually of a brown colour with a shimmer of gray and red; the front, the neck, breast, under surface, the lower portion of the legs, the tail, and hind-quarters are white; a dark stripe extends along the back to the root of the tail. The fleece is composed of a very delicate, but not very dense wool, interspersed with strong coarse hairs, which become rather longer

on the neck and hind-quarters. Wood designates the beard of the male expressly "a reverend beard." The animal frequents more particularly the elevated stony plateaux, and is generally found in troops of about thirty under the lead of an old male. At the season of heat the males are very combative. The chase is extremely difficult, especially on account of the extraordinary tenacity of life by which these animals are characterized. The Kirghiz build pyramids with their colossal horns in order to serve as landmarks in their vast solitudes.

The *Musimon* or European Mouflon (*Ovis musimon*), fig. 189, is distinguished from the giants of Central Asia even by its size, being little larger than the common sheep. This native of the mountain chains in the countries

bordering on the Mediterranean (for it was formerly found in Greece, on the island of Sicily, and the Balearic Islands) is at the present day confined to Corsica and Sardinia,

and chiefly met with on the latter, where it is still to be seen in the mountain chains of the east and centre in pretty numerous herds under the lead of an old male. The head has a curved profile, that of the male resembles the head of a ram. The horns describe a curve of three-fourths of a circle; at the base they are triangular in section, towards the end laterally compressed and marked with prominent rings.

The female is often entirely without horns; when present at all they are small and straight. The animal possesses a sturdy thickset body, with long thick legs and a small tail, which is naked at the lower end and is bent between the legs. Tear-pits and interdigital glands are present. The fleece is short and thick, and is composed of coarse hairs rather longer on the throat and breast than elsewhere. The under surface, the inner sides of the legs, and the hind-

quarters are whitish. A whitish or yellowish spot is to be seen especially on the winter fleece on the flanks. Like all wild sheep the musimon is lively and agile, a good leaper

and climber, and does not allow anyone to approach it easily. It is much hunted for the sake of its excellent flesh. It is now to be seen in all zoological gardens. It is easily rendered tame, but exhibits a peculiar stubbornness in its attacks on the bars of its cage. There was once in the Jardin des Plantes at Paris a musimon which took it into its head to break through a certain part of its inclosure. Every day it made fierce

attacks for several hours together against this spot, part of which had been strengthened with thicker stakes. The blows which it gave in butting with its horns were heard to a great distance. It would easily have broken through any other part of its inclosure, but it did not think of that, and for at least a year I continued to hear it from the workroom which M. Laurillard had given up to me, regularly repeating its onslaughts on the chosen spot.

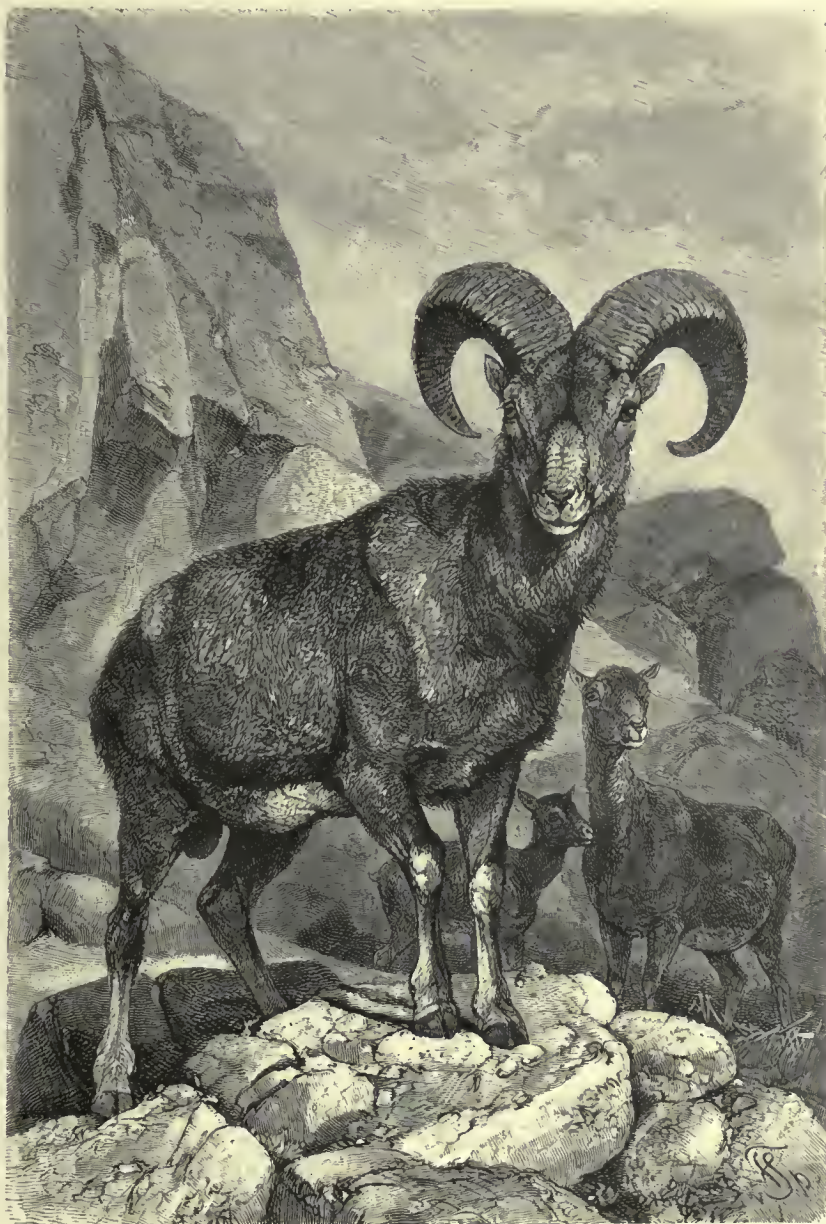


Fig. 189.—The Musimon or European Mouflon (*Ovis musimon*).

At this point we must take up the question of the **Domesticated Sheep** (*Ovis aries*), and it may be observed at the outset that there are a few important facts that dominate the whole question. In the first place, it is manifest that the sheep became domesticated among the ancient Egyptians at least much later than the ox and the horse, since the old wall-paintings which represent these two animals never represent the sheep, while we

have found drawings of the arni, from which Jupiter Ammon derived his horns. We come upon drawings of a later date, however, exhibiting sheep of various breeds, and in particular breeds with pendent ears, which is always a sign of lengthened domestication. The Egyptians of the later dynasties appear accordingly to have received this animal after it had first been domesticated elsewhere. In the second place, we must take into con-

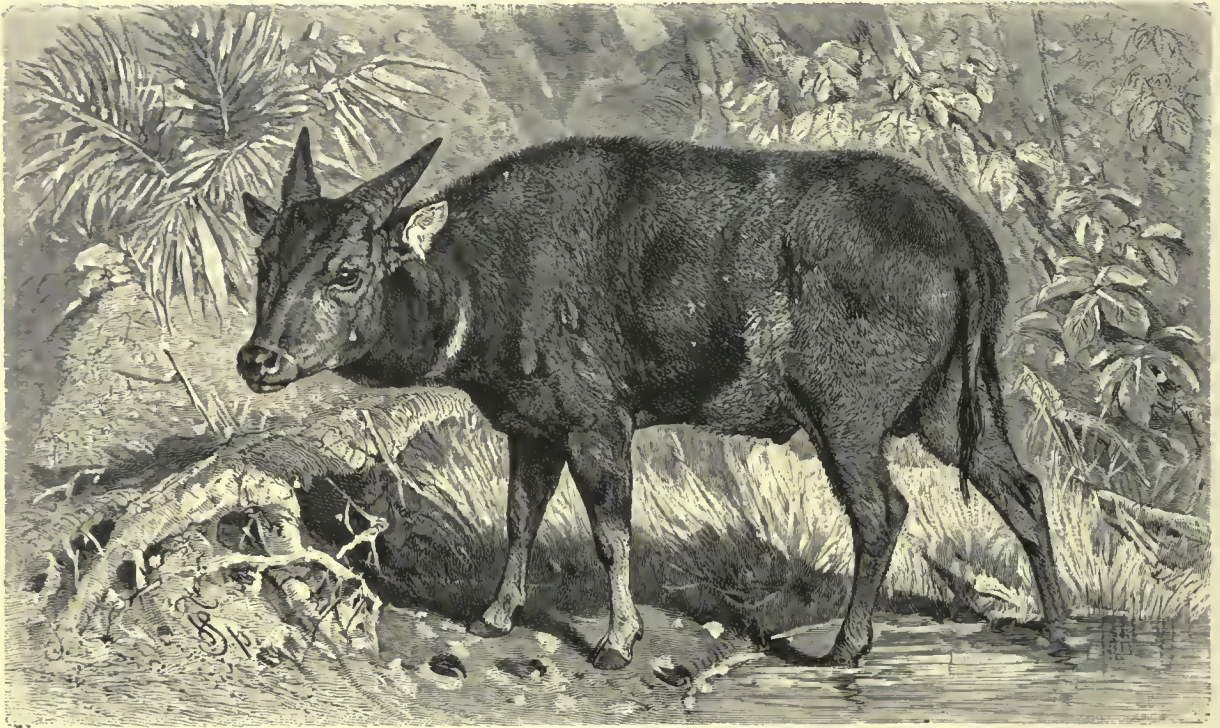


Fig. 190.—The Anoa (*Probubalus depressicornis*).

sideration the fact that there have been found representations of sheep with woolly fleece, which is likewise plainly a result of domestication; for wild sheep, such as the kashkar and the argali, may indeed have a little fine wool under the hair of which the fleece consists, but never have a fleece entirely of wool. On the other hand, remains have been found round the Swiss lake-dwellings of a long-legged sheep, whose horns resemble those of a goat, and whose descendants, but slightly altered in form, appear to have been preserved to the present day in the mountains of the Grisons. In short, the sheep is, if I may so express myself, the animal which has been least remodelled in the hands of man.

Every country, even those regions in which it is certain that there has never been any wild sheep, possesses its own peculiar race. In some cases the breeds have undoubtedly been produced according to the demand that had to be supplied—whether wool, flesh, or tail-fat, which last is the case in certain Oriental breeds, in which the tail is an enormous lump of fat, which the animal has to drag along on a small wheeled cart. Besides the wild sheep already indicated there are three or four others all belonging to Tibet, the Himalayas, or other parts of Central Asia, and all similar to the European sheep. It is accordingly probable that wild sheep have been domesticated on the spot,

and that these different species have contributed to produce the various breeds of domesticated sheep, which can easily be crossed with one another or with the still existing species of wild sheep.

The Ox Group.

The members of this group (Bovida) are distinguished from the other hollow-horned

ruminants by the massive forms of their bodies and skeletons, and their smooth round unringed horns, which have a decided curve and a hollow bony core. The forehead is broad, and so also is the moist and naked muffle. From the neck depends a dewlap; the long round tail ends in a tuft of hair; the hoofs are broad, and there are no accessory hoofs; the tear-pits are absent. On the cheek-teeth,



Fig. 191.—The Musk-ox (*Ovibos moschatus*). page 116.

at the point where the half-moon-shaped lamellæ meet, there stands a small column, which in the upper cheek-teeth is situated on the inner surface, in the lower ones on the outer surface. Like most ruminants they live in herds under the lead of an old male, are peaceable and gentle in disposition through indolence, but become terrible and dangerous during accesses of fury. When attacked they arrange themselves in a circle and show their horns to the enemy. They are fond of plains and marshy tracts.

In this group we are acquainted with two animals which form connecting links with

other cavicornia, the anoa forming the transition to the antelopes, and the musk-ox to the sheep.

The Anoa of the Malays (*Probubalus* (*Anoa*) *depressicornis*), fig. 190, has the form and general bearing of a young cow, for it attains the height of only about four and a half feet at the withers. The forehead is broad, but the head becomes more pointed towards the naked muffle. The ear is small and pointed, the eyes are large and prominent. The much-compressed horns, rounded on the outer edge, but with almost a cutting keel on the inner edge, are pretty straight,

short, very sharp-pointed, and indistinctly ringed. They are set on the head at some little distance from each other. The tail is moderately long, and tufted at the end; the legs are slender, and the accessory hoofs are pretty long. The tear-pits are wanting, the coat is dark brown, but some parts on the under jaw are white. A half-moon-shaped patch on the breast, and the inner sides of the legs are light in colour. The hair is thinly scattered. Concerning the mode of life of this animal very little is known. It dwells in the mountains of the interior of Celebes, and prefers marshy tracts. It is to be seen in certain zoological gardens, where it exhibits a rather sluggish disposition, but among the natives of the region where it is found it has the reputation of being shy and wild. The form of the horns, the colour, the slender limbs, and the presence of the accessory hoofs give it a good deal of resemblance to the antelopes in external appearance.

The **Musk-ox** (*Ovibos moschatus*), fig. 191, is found at the present day only in the polar parts of America,¹ Greenland, and the territories round Hudson's Bay, while during the Ice Age its domain extended as far as Germany and the middle of France. This is the dwarf among the oxen, for a full-grown bull measures at the shoulders only about four feet. The rather long body, resting on short legs, is completely covered with long coarse hair, which envelops also the legs as far as the knees, and leaves only the end of the mouth, the region round the eyes, the horns, and the lower parts of the legs free. Mixed with this long hair, which is of a brown colour, is a long dense and bushy wool of a gray colour which imparts a marbled appearance to the body generally. A brighter patch is observable on the buttocks. The imperfectly-developed tail is completely hidden under the fleece. The horns are very thick,

are round in section, and their swollen bases meet on the brow. They are peculiarly curved like a fishing-hook, and have their sharp ends directed forwards. The hoofs are strong and broad, the accessory hoofs are small.

The musk-ox roams over its inhospitable home in large herds. In winter it makes great migrations in order to approach the woods, but it knows how to find the mosses and lichens under the snow. It has been met with in East Greenland in places where the temperature was such as to freeze mercury. It flees from man when it has once become acquainted with him, but when driven into a corner or obliged to defend its young will charge him boldly. Its flesh is often an invaluable resource for those who are compelled to pass the winter in the dreary wastes of Polar America. That of the bull has a decidedly musky taste.

The Buffaloes.

The **Buffaloes** (*Bubalus*) form a pretty distinct sub-group, which has been raised to the rank of a genus. They are oxen with thickset bodies, thick legs, large ears placed at the side of the head, and having hair round the edges, arched brow, very broad muffle, and thick horns, which are curved first outwards and then inwards. The tail is long, the hair coarse and very thinly scattered, so that old animals are almost completely deprived of it. They are forms belonging to the warmer parts of the Old World.

The **Cape Buffalo** (*Bubalus caffer*), fig. 192, may be taken as the type of the subdivision of the buffaloes with round horns. The head is relatively small, the ears are very large, fringed with long hairs, and spread out sideways like two fans. The extraordinarily broad bases of the horns meet in the middle line of the brow, and are wrinkled and flattened. The very sharp ends are turned upwards and forwards. The small eye has a wild expression. The muffle is very broad,

¹ It was discovered by Lieut. Greely, the commander of the United States Polar expedition of 1882-83, in Grinnell Land in as high a latitude as $81\frac{1}{2}^{\circ}$ N.—TR.

the tail thin but long, the hide almost naked and very dark. The Cape buffalo lives in pretty numerous herds throughout South and Central Africa as far as the 17th degree of northern latitude. It is fond of plains and marshy forests, and delights to remain the

whole day buried in mud up to the shoulders in order to protect itself against insects by which it is infested, and from which it is partly delivered by birds that settle on its back. Terrible battles are waged between the bulls in the season of heat, and the vanquished



Fig. 192.—The Cape Buffalo (*Bubalus caffer*).

animals roam about in solitary savageness, and are then highly dangerous even to man. The Cape buffalo is, in fact, more dreaded by the natives than the lion. The solitary bulls dash with blind fury on everything that comes in their way, and conceal themselves in the bush or even behind trees in order to fall unexpectedly on men or animals passing by. All the accounts of travellers in those regions are filled with narratives of disastrous encounters with these terrible buffaloes, and there is not a village in which one does not meet with persons who have been maimed by them. When caught young they may be

tamed to a certain degree, but they are always to be dreaded on account of their liability to outbursts of fury. The hunting of the buffalo is dangerous. The flesh is good, and the thick leather made from its hide of the first quality.

The buffaloes of Asia have compressed horns placed on the sides of the brow at some little distance from one another. Their bases do not meet in the middle line.

To this group belongs the **Common Buffalo** (*Bubalus vulgaris*), which occurs both tame and wild in India, and has been introduced into Europe and Egypt, where in some dis-

tricts it takes the place of ordinary cattle. The marshes of Italy are peopled by these animals in a half-wild condition, and the buffaloes are there employed on account of their great strength for field labours, while their very rich milk, their hides, and horns are also utilized. The flesh, on the other hand, is by no means good. In India they are even ridden like horses, and no one mounted on a buffalo needs to fear tigers. The hotter the country in which these animals live the more docile and tractable are they found to be. In Egypt, for example, they are as gentle as sheep; in Italy, on the contrary, very wild.

[The following adventure will show, however, that even in Ceylon the disposition of the animal is not always so mild that its pursuit is unattended with danger. The narrator had pursued a Ceylon buffalo to the edge of a small lake, and seeing it take to the water ran round to meet it on the other side, wading in a certain distance towards it. Fifteen paces off the animal stood sullenly eyeing him, and the narrator then goes on to say:—"I took a quick but steady aim at his chest, at the point of connection with the throat. The smoke of the barrel passed to one side—there he stood—he had not flinched; he literally had not moved a muscle. The only change that had taken place was in his eye; this, which had hitherto been merely sullen, was now beaming with fury; but his form was as motionless as a statue. A stream of blood poured from a wound within an inch of the spot at which I had aimed; had it not been for this fact I should not have believed him struck.

"Annoyed at the failure of the shot, I tried him with the left-hand barrel at the same hole. The report of the gun echoed over the lake, but there he stood as though he bore a charmed life; an increased flow of blood from the wound and additional lustre in his eye were the only signs of his being struck.

"I was unloaded, and had not a single ball remaining. It was now his turn. I dared not turn to retreat, as I knew he would immediately charge, and we stared each other out of countenance. With a short grunt he suddenly sprang forward, but fortunately, as I did not move, he halted; he had, however, decreased his distance, and we now

gazed at each other within ten paces. I began to think buffalo shooting somewhat dangerous, and I would have given something to have been a mile away, but ten times as much to have had my four-ounce rifle in my hand. Oh, how I longed for that rifle in this moment of suspense! Unloaded, without the power of defence, with the absolute certainty of a charge from an overpowering brute, my hand instinctively found the handle of my hunting-knife, a useless weapon against such a foe.

"Knowing that B. was not aware of my situation at the distance which separated us (about a mile), without taking my eyes from the figure before me I raised my hand to my mouth and gave a long and loud whistle; this was a signal that I knew would be soon answered if heard.

"With a stealthy step and another short grunt the bull again advanced a couple of paces towards me. He seemed aware of my helplessness, and he was the picture of rage and fury, pawing the water and stamping violently with his fore-feet.

"This was very pleasant! I gave myself up for lost, but putting as fierce an expression into my features as I could possibly assume, I stared hopelessly at my maddened antagonist.

"Suddenly a bright thought flashed through my mind. Without taking my eyes off the animal before me, I put a double charge of powder down the right-hand barrel, and tearing off a piece of my shirt, I took all the money from my pouch, three shillings in sixpenny pieces, which I luckily had with me in this small coin for paying coolies. Quickly making them into a rouleau with the piece of rag I rammed them down the barrel, and they were hardly well home before the bull again sprang forward. So quick was it that I had no time to replace the ramrod, and I threw it into the water, bringing my gun on full cock in the same instant. However, he again halted, being now within about seven paces from me, and we again gazed fixedly at each other, but with altered feelings on my part.

"At this time I heard a splashing in the water behind me accompanied by the hard breathing of something evidently distressed. The next moment I heard B.'s voice. I dared not turn my face from the buffalo, but I cautioned B. to reserve his fire till the bull should be close into me, and then to aim at the head.

"The words were hardly uttered when, with the concentrated rage of the last twenty minutes, he rushed straight at me! It was the work of an instant. B. fired without effect. The horns were



To face page 118.

PLATE XXXI. — THE EUROPEAN BISON (*Bison europaeus*).

lowered, their points were on either side of me, and the muzzle of the gun barely touched his forehead when I pulled the trigger, and three shillings' worth of small change rattled into his hard head. Down he went, and rolled over with the suddenly checked momentum of his charge. Away went B. and I as fast as our heels would carry us through the water and over the plain, knowing that he was not dead but only stunned. There was a large

fallen tree about half a mile from us, whose whitened branches, rising high above the ground, offered a tempting asylum. To this we directed our flying steps, and after a run of a hundred yards we turned and looked behind us. He had regained his feet and was following us slowly. . . .

"On he came, but fortunately so stunned by the collision with her Majesty's features upon the coin which he had dared to oppose that he could only



Fig. 193.—The Kerabau Buffalo (*Bubalus Kerabau*).

reel forward at a slow canter. By degrees even this pace slackened, and he fell."—Sir Samuel Baker, *Rifle and Hound in Ceylon*.]

Fig. 193 gives an illustration of the **Kerabau Buffalo** (*Bubalus Kerabau*) as a representative of this group with flattened horns. This animal is a native of the Eastern Archipelago from Celebes to the Philippines. In size it is equal to the largest buffaloes of the Kaffir country. The head is rather long and slender, the muzzle is broad, the body long and plump, the dewlap only slightly developed, the colossal flattened horns have well-marked rings and are gently curved first outwards and then backwards. In a wild state this animal lives, like other buffaloes, in morasses; when tamed it is very gentle and tractable in the hands of the natives, but ill-tempered and dangerous towards Europeans. It is em-

ployed like other buffaloes as a beast of draught and burden. Specimens of it have been brought to Europe, and have been paired with the common buffalo.

The Bisons.

The **Bisons** (*Bison*) likewise form a separate group, the members of which are characterized by their broad arched brow, their small short horns, which are thick and bent upwards, by their coat of long thick hair, and by their height at the withers, which part presents a marked contrast to the relatively small hinder quarters. There are two species of bisons, one of which lives in Europe and Western Asia, and the other in America.

The **European Bison** (*Bison europæus* (*bonasus*)), Pl. XXXI., has at all times had the singular fortune to be confounded with another

large member of the ox tribe, the **Ur** or **Auerochs**, while the inhabitants of the countries to which they belonged distinguished these two rather different species very well. Both species were favourite objects of the chase in the middle ages. In the account of Siegfried's hunting expedition at Worms, which is introduced into the *Nibelungenlied*, an account in which mention is made of all the leading kinds of game then hunted in Germany, two species of wild cattle, namely, the **Bison** and the **Ur**, occur among the number. The Poles also had separate names for the two species, distinguishing the one as **Subr** and the other as **Tur**. Pliny likewise mentions the same species, which in his day were brought to Rome for the games of the circus, and distinguishes the **Bonassus** with its thick mane from the **Urus** with its terrible horns. It was only about the sixteenth century that the two species began to be confounded in Western Europe. At that time the urus was already extinct or had been transformed into domesticated cattle, while the bison survived only in Poland. The name of the extinct animal was transferred to the survivor, and the bison was called also the **Ur**, **Aur**, or **Auerochs**, a name which has, unfortunately, been preserved in French nomenclature, but which ought to be allowed to drop out of use altogether in order to prevent the confusion from becoming endless.

We see then that the bison, the **Wisent** of the Germans, the **Subr** of the Poles, still exists. It is found at the present day in the large forests of Bialowicza, in the government of Grodno in Lithuania, and in the heart of the Caucasus, in the vicinity of the sources of the Terek and the Kuban. It is an animal of huge size. An old bull may attain the height of $7\frac{1}{2}$ feet at the withers. The head, with its broad arched forehead, short ears, and broad swollen muffle, carries the small round sharp horns, which are turned upwards in such a manner

that the points stand over the roots at the edge of the brow. The legs are short and sturdy, the hoofs rounded, the accessory hoofs small, and the short thick tail carries a tuft of hair at the end. A thick coat composed of wool and of long soft hair envelops the breast, shoulders, and withers, and forms a sort of mane on the head and neck. It becomes considerably longer underneath the dewlap, between the horns, and upon the withers, which, apart from this, are so high that the animal appears to carry a hump. The close-set but shorter hair covers all the rest of the body. The colour is a dark brown on the back, lighter on the sides.

Bisons live in herds, which were formerly numerous, under the leadership of one of the older bulls, and generally frequent marshy woods when they can. They are savage and courageous, terrible in attack, and dash with fury on the hunter who ventures to pursue them. Formerly, when it was considered the rule to kill the animal with the naked weapon, the hunting of the bison was looked upon as a battle for life or death. The bisons that are found at the present day in our zoological gardens are descendants of a few pairs which were captured young, and presented by the Russian emperors, by whose command the wild animals of the forest of Bialowicza are strictly preserved. The bisons are always savage in their disposition, and the cows, in themselves much more tractable than the bulls, invariably kill their calves, to which they are extremely devoted, when the hand of man has touched them. The flesh was at one time esteemed, and as late as the year 1000 the vassals of the monastery of St. Gall had to hand over the bisons killed by them to the kitchen of the bishop.

The **American Bison** (*Bison americanus*), Pl. XXXII., which likewise occupies a full-page plate, is not essentially different from the European. The hair is thicker and longer both on the general surface of the body and on the parts occupied by the mane.



To face page 120.

PLATE XXXII. — THE AMERICAN BISON OR BUFFALO (*Bison americanus*).

The hump is more prominent, the tail shorter, and the horns thicker; but in other respects the two species are closely similar.¹

Formerly the bison roamed in enormous herds over the whole territory of the United States as far as the Rocky Mountains. The pursuit, or, as we well may say, the senseless slaughter which has been practised by Indians and settlers has driven it back to the prairies on the other side of the Mississippi, and has compelled it to seek refuge at the present day either on the west side of the Rocky Mountains or in the northern regions. It is easy to foresee the time in which the American bison, like his European cousin, will be quite extinct. Those bisons still traverse the prairies in herds of several thousand head,² swim across the largest streams, and undertake great migrations. Since the introduction

¹ It may be worth while to draw attention here to an error that has crept in a very singular manner into many accounts of the European and American bison. The error is as to the number of ribs, the European bison being stated to have fourteen, and the American fifteen pairs of ribs. The fact is, that both species have the same number of ribs, namely, fourteen pairs. In a note on this subject, J. A. Allen, in his *American Bisons, Living and Extinct* (p. 2), says:—"In this case the error had a singular origin, and its repetition is to some degree justifiable. The first skeleton of the American bison known in Europe was that obtained from a living specimen received at the Paris menagerie in 1819, and which was described by Cuvier in his *Ossements Fossiles* (tome iv. p. 118 of third edition). This specimen—one instance probably in thousands—chanced to have *fifteen pairs of ribs*, and consequently but four lumbar vertebræ. Cuvier, of course, called attention to this fact as affording an important distinction between the American and European bisons. . . . It is hence not strange that mere compilers, and even authorities of some eminence, should for a time perpetuate the error, especially since it was many years before a second skeleton of the American bison fell under the eye of a comparative anatomist. Yet it seems a little strange to find it repeated by leading English anatomists and zoologists for many years after several of the leading museums of Great Britain contained skeletons of the American bison. Owen, as late as 1866, in his great work on the *Comparative Anatomy of the Vertebrates* (vol. ii. p. 462), says: 'The European bison has fourteen dorsal and five lumbar vertebræ; the American bison has fifteen dorsal and four lumbar, and this is the extreme reached in the Ruminant order, of movable ribs, equalling in number those of the hippopotamus.'"—TR.

² This was probably still true at the date when it was written, but so rapid has been the destruction of this animal in recent years that the National Museum of the United States not long ago thought it necessary to send out an expedition to collect a few specimens before it was completely exterminated. A report furnished to the museum about the middle of 1886 shows what difficulty the expedition had in fulfilling its mission in consequence of the extinction of this species having been so nearly effected already. "It is firmly believed by good authorities," the report states, "that there are not now more than from fifty to one hundred buffaloes in the whole of Montana [where a few years ago this animal was remarkably abundant], outside of the National Park, where there are probably from two hundred to three hundred head."—TR.

of horses and fire-arms into America they flee from man, or only very seldom try to make head against him. When they have once begun to run they plunge on like sheep, with head held down, in dense crowds. They are hunted partly for the sake of the sport, but also for their excellent flesh, their fleece, and their hides. The efforts that have been made to domesticate them have not been successful;³ yet in our zoological gardens they are not so savage as the European bison, and they are easily reproduced in confinement.

[Throughout North America this animal is known as the "buffalo." "I suppose," writes Dodge, one of the veterans of sport in the United States, "I ought to call this animal the 'bison;' but, though naturalists may insist that 'bison' is his true name, I, as a plainsman, also insist that his name is buffalo.

"As buffalo he is known everywhere, not only on the plains, but throughout the sporting world; as buffalo 'he lives and moves and has his being;' as buffalo he will die; and when, as must soon happen, his race has vanished from earth, as buffalo he will live in tradition and story."—*Plains of the Great West*.

The hunting of the buffalo is pursued either on horseback or on foot, the latter mode being called the "still hunt." "Although," writes Dodge, "there is not a particle of danger in approaching a herd, it requires in a novice an extraordinary amount of nerve. When he gets within three hundred yards, the bulls on that side, with heads erect, tails cocked in air, nostrils expanded, and eyes that seem to

³ On this subject the following passages from J. A. Allen's *American Bisons, Living and Extinct*, are worth quoting:—

"Now that the buffalo is apparently so nearly exterminated, it is greatly to be regretted, not only that its ultimate extinction has been so rapidly hastened by improvident and wanton slaughter, but that no persistent attempts have as yet been made to utilize this valuable animal by domestication. . . . That the buffalo calf may be easily reared and thoroughly tamed needs not at this late day to be proved. The known instances of their domestication are too many to admit even of enumeration, but they have usually been kept merely as objects of curiosity, and little or no care has been given to their reproduction in confinement, and few attempts have been made to train them to labour."

After quoting accounts of several instances in which domestication had been successfully effected, the writer concludes: "From the foregoing the following facts are sufficiently attested: (1) That the buffalo is readily susceptible of domestication; (2) that it interbreeds freely with the domestic cow; (3) that the half-breeds are fertile; and (4) that they readily amalgamate with the domestic cattle." *American Bisons*, sec. 4.—TR.

flash fire, even at that distance, walk uneasily to and fro, menacing the intruder by pawing the earth and tossings of their huge heads.

"The enemy still approaching, some bull will face him, lower his head, and start on a most furious charge. But alas for brute courage! When he has gone twenty or thirty yards Mr. Bull thinks better of it, stops, stares an instant, and then trots back to the herd. Another and another will try the same game, with the same result; and if, in spite of these ferocious demonstrations, the hunter still approaches, the whole herd will incontinently take to its heels."

The professional hunter, when desiring to load his teams with meat, advances as close to the herd as he can, concealed as far as possible by the grass and the inequalities of the ground, and "will rarely make his first shot at a greater distance than fifty to seventy-five yards. If the shot result fatally, the herd rarely moves more than fifty yards before stopping to look for the cause of the mishap to their fallen companion, and turning half round to get a good view rearward, they thus present themselves in the best possible position to the hunter at still short range. Here others fall before the hunter's shots; the herd, again slightly startled, moves on a few paces, and again stops to gaze. The hunter, still keeping prostrate, approaches, if necessary, under cover of those already killed, and continues the work of destruction. The shots are thus often repeated till fifteen, twenty, or even thirty buffaloes are killed before the herd becomes thoroughly alarmed and, in hunter's parlance, 'stampedes.' By keeping prostrate the hunter is able to creep up to the herd again as it recedes, till he has killed enough to furnish loads for his teams; and even sometimes he has to rise and drive away the stupid creatures to prevent the living from playfully goring the dead! When the hunter is thus successful, it is termed 'getting a stand on the herd.' A 'stand' is most surely made in nearly level ground. In shooting from ravines, the herd usually runs away after three to five or six of their number have fallen. During the rutting season, if a cow falls at the first shot, the hunter is pretty sure of a 'stand;' and of getting a dozen or more shots, if he keeps prostrate and uses due caution. As soon as he rises the buffaloes seem at once to recognize the cause of their trouble, and generally immediately stampede; but so long as he remains prone they seem to have no perception of the character of their enemy, and often do not

notice him at all."—Allen: *The American Bisons*, sec. 3.

"Buffalo hunting on horseback," however, "is a very different thing, and, to a novice, full of excitement. A buffalo can run only about two-thirds as fast as a good horse; but what he lacks in speed he makes up in bottom or endurance, in tenacity of purpose, and in most extraordinary vitality.

"A herd will stand staring at an approaching horseman until he is within about three hundred yards. It will then begin to move off slowly, and, when he is within about two hundred and fifty yards, it will probably break into a gallop. This is the sportsman's moment. A good horse ridden by a man who knows his business will be among them before they have gone two hundred yards, to shoot and slaughter at his pleasure. A poor horse, or careful rider, and the hunter will find to his sorrow that 'a stern chase is a long chase.' If a herd is not overtaken in five or six hundred yards the chase had better be abandoned, if any regard is to be had for the horse. The difficulty in this hunting is that the herd is enveloped in a cloud of dust, which prevents very careful aim; the explosion of the pistol creates a turmoil, confusion, and change of places among the flying animals, rendering it almost impossible to shoot at any individual buffalo more than once; and their vitality is so great, that it is an exceedingly rare exception when one is brought down by a single shot.

"The danger is not so much from the buffalo, who rarely makes an effort to injure his pursuer, as from the fact that neither man nor horse can see the ground, which may be rough or broken and perforated with prairie-dog or gopher holes. This danger is so imminent that a man who runs into a herd of buffalo may be said to take his life in his hand.

"I have never known a man hurt by a buffalo in such a case. I have known of at least six killed, and a very great many more or less injured, some very severely, by their horses falling with them.

"The knowledge of the danger, the rush of the horse, the thundering tread of the flying brutes, the turmoil, the dust, the uncertainty, and, above all, the near proximity and ferocious aspect of the lumbering throng, furnish excitement enough to set wild the man who is new to it. There is, however, a sameness about it which soon palls, and an old buffalo hunter rarely runs buffalo."—Dodge.]

The True Oxen.

The True Oxen (*Bos*) are distinguished by their straight back, not elevated at the withers, and by their unarched and not very broad forehead.

The Yak (*Bos (Poëphagus) grunniens*), fig.

194, approaches most closely to the bisons in the possession of a thick coat of hair, elevated withers, and slightly arched brow. The home of these enormous cattle is the mountains and plateaux of Tibet, from the height of about 13,000 to 23,000 feet above sea-level. They are the largest members of the genus,



Fig. 194. —The Yak (*Bos grunniens*).

old bulls sometimes attaining the height of nearly 10 feet at the withers. The very broad head with protruding muzzle and not very broad muffle, carries relatively small horns, which are flattened and near the base ringed. They are placed quite at the side and have their sharp points directed upwards. What specially distinguishes the yak is the woolly covering, consisting of fine silky hair, which is rather loose on the brow, and on the rather hump-like withers forms a long-fringed cushion. The yak has likewise long and partly curly hair on the dewlap and on the legs, which are completely hidden under this covering. The legs are short but strong, with broad hoofs but small accessory hoofs. The long tail resembles that of a horse. Its

fine silky hair trails upon the ground. The whole fleece is of a deep-black colour with the exception of one silver-gray stripe along the back, and the tail, which is almost white.

This splendid animal is at home only in the rocky solitudes of its native region, where it delights in rolling in the snow and bathing in the icy mountain torrents. It runs and climbs well, but is in general sluggish and indolent; it is fond of reposing where it can chew the cud at leisure. Its scent is keen, its sight weak, and its intelligence very limited. It stares stupidly when wounded in the chase, then begins to charge the hunter, but is apt to halt in indecision so as to receive a second ball. The hunting of the yak is carried on very actively, not only

for the sake of its excellent flesh, but more particularly on account of its tail, which is employed to sweep away flies, and is held in no little esteem as an ornament for banners and as an emblem of war among the tribes of the highlands of Central Asia. The so-

called horse-tails of the pashas and beys were originally yak tails. The ancients knew this species under the name of *Poëphagus*. The yak has been tamed, and is employed chiefly to ride on and as a beast of burden. Its milk also is used. Domesticated yaks are gentle,

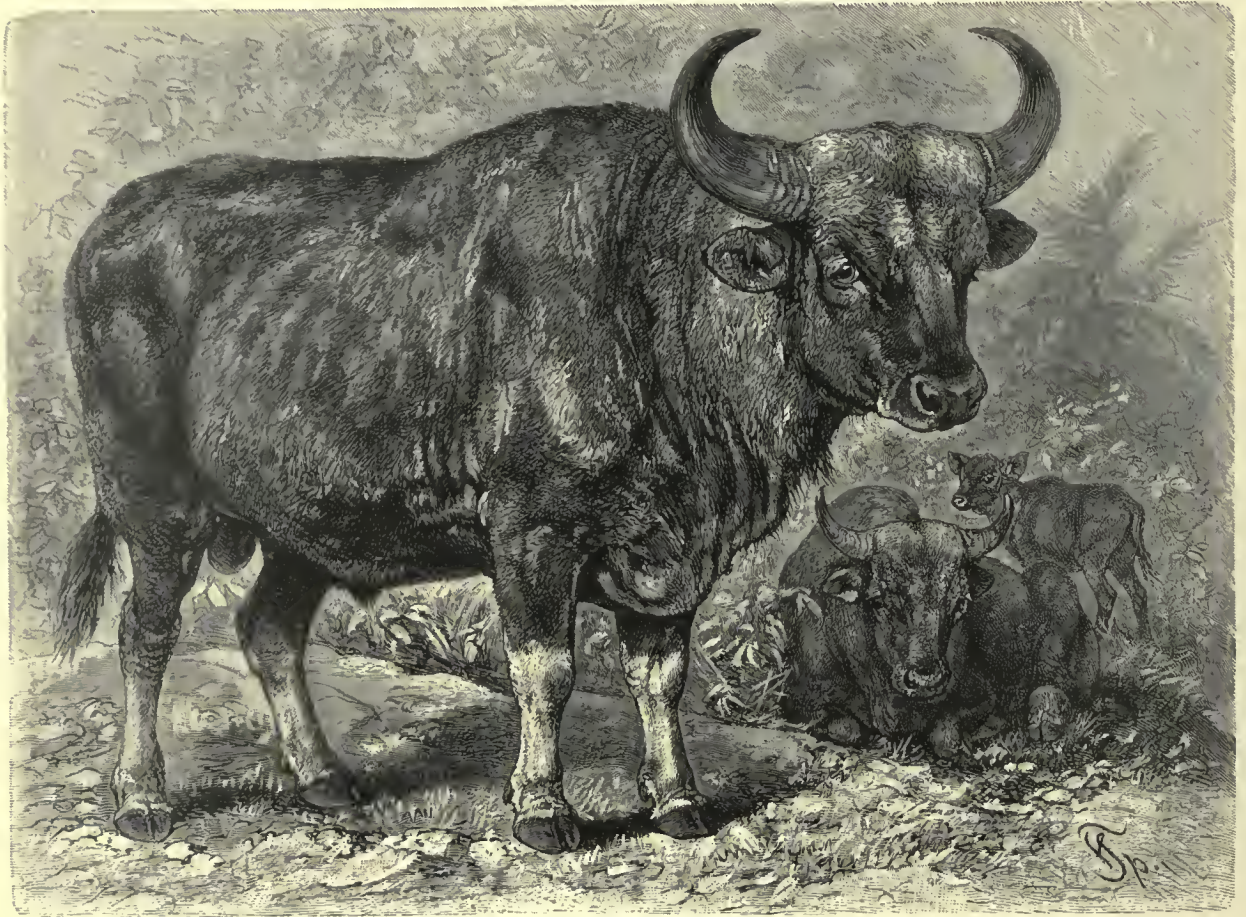


Fig. 195.—The Gaur (*Bos gaurus*).

readily associate with ordinary oxen, and are contented with any kind of food, but are liable at times to outbursts of fury. They carry tolerably large burdens in those elevated regions where it is difficult for both men and animals to breathe. The yak is now to be seen in all zoological gardens.

The Gaur (*Bos (Gavæus) gaurus*), fig. 195, is a native of the Indian Peninsula, where it is often known by the name of the bison. It is most abundant in the southern part of the peninsula, and prefers the stony wooded or bushy heights. It closely resembles the large species of our domesticated oxen, has short shining hair, a short thick head, long

ears, and a tufted tail. The colour is a very dark brown, almost black, but the feet are white. At the shoulders, where there is very little indication of a hump, the height is nearly $6\frac{1}{2}$ feet. The old bulls are dangerous when hunted; but if a few English officers have lost their life in the chase, one ought to bear in mind that these gentlemen expose themselves to danger with rather too naïve rashness. The natives have sometimes managed to tame specimens of this, ox. In Europe this species is rarely seen.

The Gayal (*Bos (Bibos) frontalis*), fig. 196, is a distinct species rarely brought to Europe, a native of the mountains on the east and

north-east of Bengal. It is specially distinguished by its very broad and short forehead, and by its thick, conical, and slightly curved horns. The body is sturdy, thickset, and clumsy; the shoulders are slightly elevated into a hump; the legs are short; the

colour of the coat black. At Antwerp I have seen this animal represented as the ideal of an ox by a celebrated artist. I confess that I have conceived a totally contrary impression of it. However that may be, we are assured that the gayal in its native



Fig. 196.—The Gayal (*Bos frontalis*).

country is a very agile animal, and not at all savage. It is said to flee from man, but defends itself vigorously against other oxen. It is easily tamed, and whole herds of gayals are captured by gradually accustoming them to associate with domesticated oxen.

The **Burmese Wild Ox**, the Banteng of the Javanese (*Bos (Gavæus) sondaicus*), fig. 197, is found on Java, Borneo, and Sumatra, and resembles some species of our domesticated oxen so much that it could not be distinguished from them if a single individual happened to be met with in a herd. It is far inferior in size to the yak; a full-grown bull measures only 5 feet at the shoulders.

It might be described as a race of oxen with slender legs, short broad head, moderately long horns, which are turned only upwards, and with a fine smooth reddish-brown coat, which shows white patches on the lips, the lower parts of the legs, and on the hinder quarters. It is found everywhere on the Sunda Islands where there is water or marshy ground, both on the mountains and on the plains. It always flees from man, but defends itself when attacked, and it is much hunted on account of its excellent flesh. It also is easily tamed. The natives are accustomed to drive their cows into the woods in order that they may unite with the banteng bulls.

The **Zebu or Humped Ox** (*Bos indicus*), fig. 198, is still found in a wild state in several parts of India, but it is a question whether these are not domesticated animals run wild. The wild specimens are in no respect different from the tame, numerous breeds of which

are distributed over India and Africa. It is remarkable on account of a cushion of fat forming a hump on the shoulders, as well as for its rather large dewlap, and is also characterized by its pendent ears, the straight line of its back, its pretty long slim legs, and



Fig. 197.—The Burmese Wild Ox (*Bos sondaicus*). page 125.

its usually bright-coloured or spotted skin. The size varies. The South African breeds are commonly large and brown, and often have horns of considerable size; but in all countries where they are found there are also moderate-sized and small breeds, even genuine dwarfs of about the size of a large pig. Then there are also breeds with moderate-sized or small horns, or even without horns at all. The zebus run, trot, and gallop like horses; they are highly esteemed as steeds and as beasts of draught and burden, and among some tribes, especially in South and Central Africa, they form, so to speak, the sole wealth.

The zebus furnish a contribution to the solution of the question of the origin of the domesticated breeds of cattle. According to the results of the investigations of Rüttimeyer, which have indeed been confirmed by other inquirers, but are nevertheless far from having exhausted the question, the European breeds are derived from three races or species, the remains of which are found in a fossil condition in the Quaternary strata. Some of these species have lived along with man, but have afterwards become extinct or have been modified through the influence of man.

The first place among these primitive species belongs to the **Urus, Ur, or Auerochs**

of the Germans, the *Tur* of the Poles (*Bos primigenius*), which in the middle ages still lived wild in Central Europe, and which was equal in size to the bison, or even surpassed it. It was dreaded in the chase, and according to the account of a contemporary, differed "from the tame cattle only in being black and in having a whitish stripe on the back."

According to Rüttimeyer a white kind of cattle with black or red ears preserved in some English and Scottish parks, as in that of Chillingham belonging to Lord Tankerville, and the high parks of the Duke of Hamilton at Hamilton, almost in a wild state, is the most direct and least modified descendant of the Auerochs. The tame breeds of the

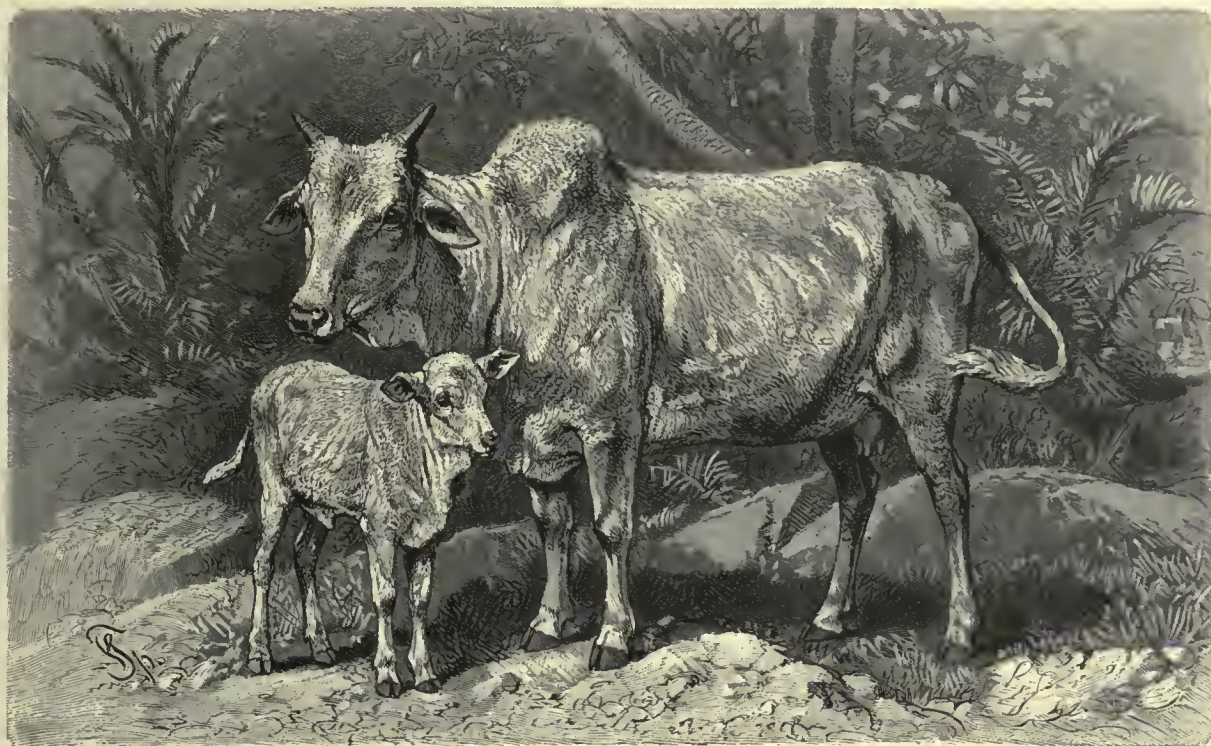


Fig. 198.—The Zebu (*Bos indicus*).

lowlands bordering on the North Sea and the Baltic, the breeds of Friesland, Holland, Holstein, and Podolia, and so on, are likewise said to be more modified descendants of the same stock, the *urus*.

The heavy spotted breeds of Central Europe, the spotted cattle of France, of Switzerland, and South Germany, the Scandinavian and English races with rudimentary horns or without horns at all (short-horns of the English) are said, on the other hand, to be descended from a Quaternary ox, to which the name of *Bos frontosus* has been given, and which had a rather long head with a brow either flat or even hollowed out in front, and long curved horns.

Finally, the uniformly coloured unspotted breeds with short strong horns, not so plump

bodies, and less massive legs, breeds which are chiefly to be found in hilly or mountainous countries; the breeds accordingly of the Highlands of Scotland, of Brittany, Auvergne, Schwyz, and similar districts, are believed to be derived from another stock, the *Bos brachyurus*, numerous remains of which have been found in the vicinity of the lake-dwellings.

We give our entire assent to these conclusions, but, as we have already intimated, they are far from exhausting the question. When we consider the ease with which buffaloes, yaks, zebras, and almost all other wild races of cattle can be tamed, acclimatized, and rendered serviceable, such attempts must have been made in the remotest antiquity in all countries where such races of wild cattle

were found. Now these tamed breeds must, through the wanderings of tribes, through mutual exchanges of many kinds, have got mixed together, and new breeds would all the more easily be formed since all these races are mutually fertile.

As a proof of what we have now advanced we may point to what has actually happened in Africa. On that continent no Quaternary cattle have yet been found, and, with the exception of the variety of races introduced in recent times by the Europeans, we may probably say that the whole of the interior of the continent was peopled by various zebu races, from which in some cases the hump has disappeared. It is accordingly probable that the native African races were introduced from India and have become more or less modified on this continent. Now the ancient Egyptians already knew and reared three different races of cattle, as is proved by numerous representations; one race with long horns was greatly revered because it produced the bull Apis, a second had short horns, and the third had a hump, consisted in fact of true zebus. This is a clear proof that in that long-past epoch importations had already been made from other countries, and in particular from Central Asia, where there are no zebus.

If now in Europe alone there are three ancient stocks which have been continued in varieties of domesticated cattle of the present day, there is no reason to reject the opinion which supposes the same thing to have taken place in Asia, where the species which are still found partly tame and partly wild have certainly contributed to the production of mixed races and of breeds more or less modified by domestication. From all these facts it would result as a final conclusion that tame cattle are not, as Linnæus called them, a separate species, *Bos taurus*, but a mixed product of extremely numerous and very diverse factors, developed in widely separated regions of the Old World.

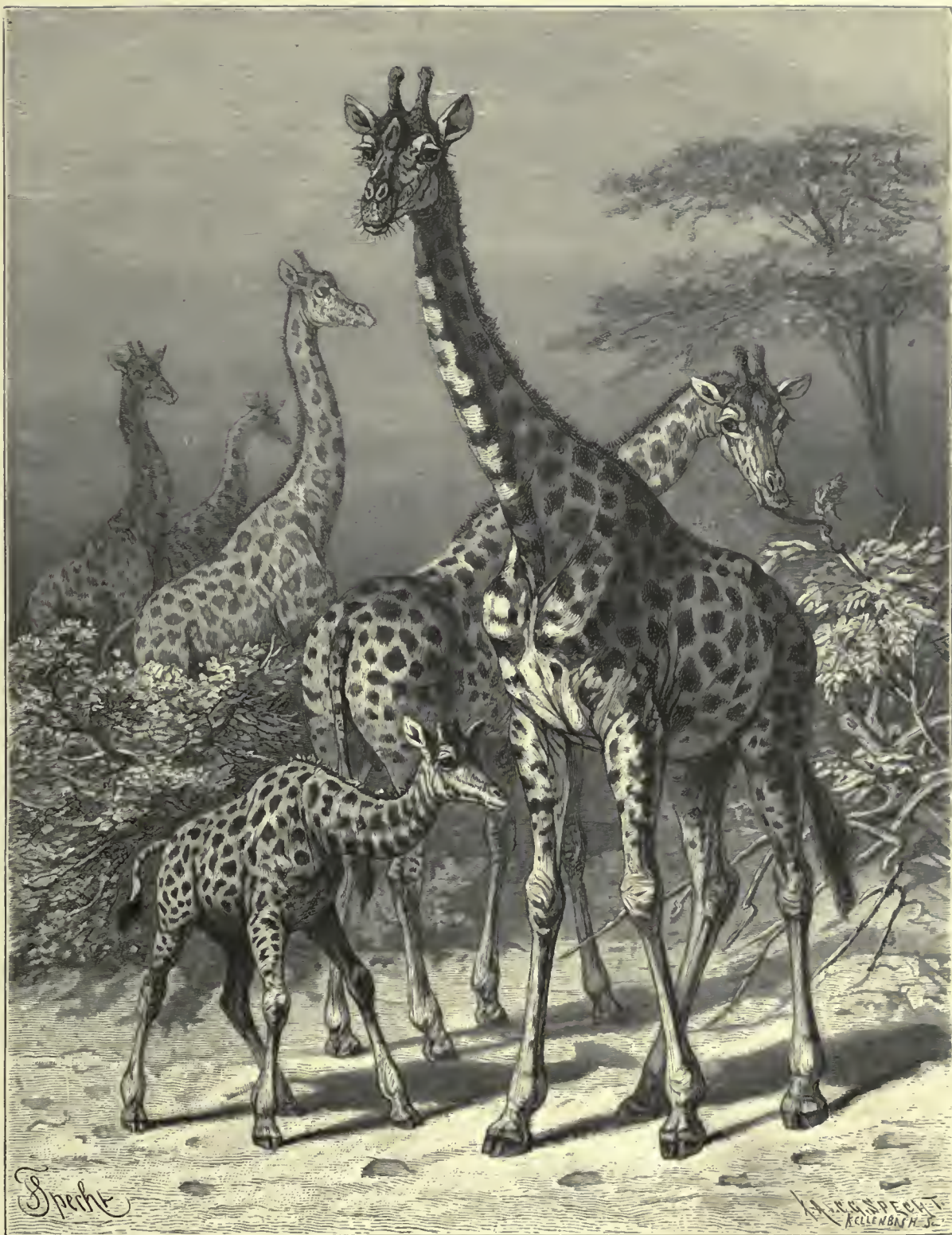
THE GIRAFFE FAMILY

(DEVEXA).

The family of the giraffes, which on account of their very sloping back have been called *Devexa*, is composed of only a single species, confined to Africa, namely the Giraffe (*Camelopardalis giraffa*), Pl. XXXIII.

This is without doubt one of the most singular types that can be seen, and we can easily understand the astonishment of the beholders when they first set eyes on the small head carried at the extremity of an excessively long neck about twenty feet above the ground, and the short body with its steep backward slope elevated on legs not less long or less stiff. Notwithstanding its beautiful coat and its splendid eyes the giraffe must certainly be pronounced one of the most disproportioned of mammals, one in which everything is stiff and angular.

The head is relatively very small and rather long and narrow. It ends in a muffle with very mobile lips, and is adorned with two short horns covered with hair set upon the occipital bone, as well as with a swelling between the large prominent eyes, which are placed at the side, and are distinguished by their brilliancy and their gentle but lively expression. The pointed funnel-shaped ears are longer than the horns. The tongue is worthy of special note. It is long, worm-like, dark-blue in colour, very flexible, and capable of serving as a tactile and prehensile organ. The giraffe twines this tongue round the twigs and leaves of the trees on which it feeds. Although, as in almost all other mammals, the neck of the giraffe has only seven vertebræ, it is yet of immoderate length. It is by no means flexible, and is almost always carried erect. The short thick body is remarkable on account of the steep slope of the back from the shoulders to the croup, a slope which is due to the increasing length from behind forwards of the spiny processes of the



To face page 178.

PLATE XXXIII. — THE GIRAFFE (*Camelopardalis giraffa*).

dorsal vertebræ. The tail is thin, of moderate length, and ends in a long thick tuft of hair. The legs are of equal length, and the bones of the lower parts of the legs, including the metacarpal and metatarsal bones, are excessively elongated, while the upper arm (humerus) and thigh (femur) are short and hidden in the flesh. The hoofs are broad, and there is no trace of accessory hoofs or of the bones which carry them. Of all ruminants the giraffe is the one that has the foot most reduced. Tear-pits and interdigital glands are likewise wanting. The dentition is similar to that of the Cavicornia. The hair is for the most part thick and short; there are only a few longer and coarser hairs on the middle line of the neck besides the very long ones of the tail. The ground colour of the coat is a light-yellow, almost white on the back and on the lower parts of the legs, which are not spotted. The other parts show irregular but always polygonal and often pretty large brown spots.

The animal inhabits the steppes and deserts of the tropical parts of Central Africa. It is always met with in small troops, which haunt in particular those places where mimosas and other trees form very open clumps. With the exception of the eyes all the organs of sense seem to be very obtuse, and the intelligence of the creature is assuredly not very high. The giraffe feeds on the leaves and young shoots of trees, which it is enabled to reach by the enormous length of its neck and the protrusible tongue. The grazing of grass is difficult for it, and it is enabled to reach anything on the ground only by spreading out its fore-legs as widely as possible, which gives it almost a comical attitude. It cannot trot, but it gallops with great rapidity, and when galloping it holds its long stiff neck erect like a mast and keeps swinging it from side to side, while at the same time it lashes its back with its tail. Its pursuers hunt it on horseback or mounted on fleet dromedaries, relays being stationed at different points,

where fresh riders and animals take up the chase.

The ancient Egyptians received giraffes as tribute from the subject tribes of the Soudan. Julius Cæsar brought the first giraffes to Rome. In our times the first two young giraffes were brought to Europe in 1827, one to Paris and one to London. They excited great attention; there were even fashions "à la girafe" introduced. Since then they have been brought over in tolerably large numbers, and all zoological gardens now possess specimens. They are in general gentle and easy to manage, but do not stand our climate very well. They are specially liable to become rachitic if not carefully protected from draughts and rain, which last inspires them with a real dread.

THE CAMEL FAMILY

(CAMELIDA).

The family of the camels has also received the name of the **Pad-footed** (*Tylopoda*), on account of the singular structure of their feet, which are but slightly cloven and carry small narrow hoofs seated on a broad rounded warty pad forming the sole.

The structure of the teeth is not less remarkable. The camels are the only ruminants which have incisors in the upper jaw. Young animals have three of these on each side; but the inner ones soon drop out and are not replaced. In older animals there is in each half of the premaxillary bone only a single large incisor, which is prominent, conical, and pointed like the canine, but smaller. In the lower jaw there are three pairs of incisors, and immediately behind the last there stands the large pointed canine, similar to the upper, which, however, is separated from the incisors by a diastema. The jaws are, accordingly, much better armed in front than in the other ruminants, and in the countries of which the camels are natives it is very well known that their bite is not without danger. Immediately

behind the canine there comes a premolar, which is shed sooner or later, and which also resembles the canine in form. The diastema occurs between this canine-shaped premolar and the other cheek-teeth. The latter are constructed according to the ordinary ruminant type. As age advances some of the molars are shed; we then find in the upper jaw only five instead of six, in the lower only four instead of six. The camels have no horns.

The family is composed of only two genera, which are geographically separated by the oceans; the camels proper belong to the Old World, the llamas to South America.

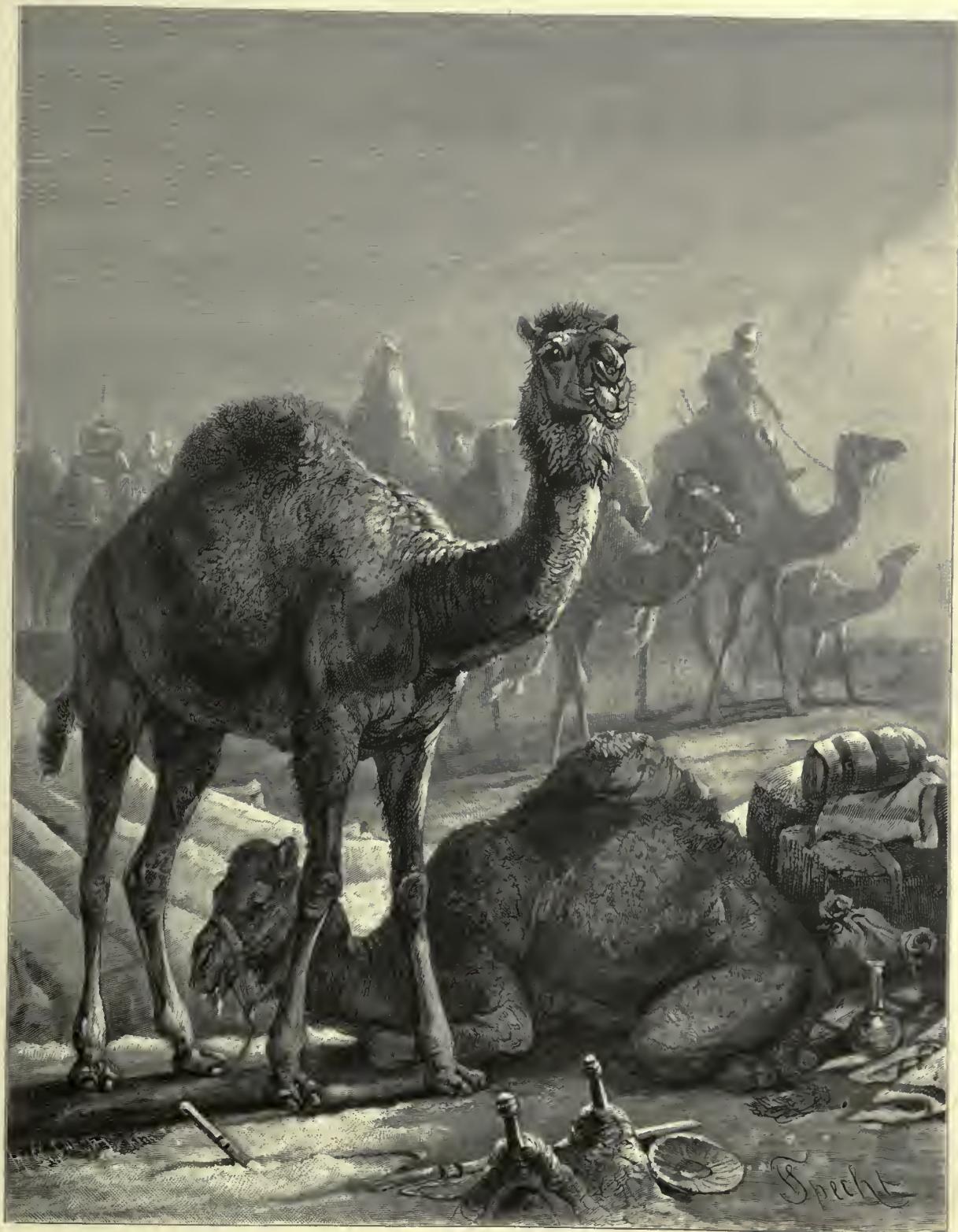
The Camels.

The **Camels** (*Camelus*) are among the largest of the ruminants, for they attain at the shoulders a height of about $8\frac{1}{2}$ feet. The head is very unshapely, the brow arched, the mouth long, and broad at the end; the large upper lip is a little cloven in the middle and protrudes beyond the pendent lower lip. The broad movable nostrils are placed above the mouth, but far from the end of the snout. The large prominent eyes are not in the least expressive; the ears are small; the back of the head somewhat round, and occupied near the back by two skin-glands, which, especially in the breeding season, excrete a fluid of a peculiarly disgusting smell. The long neck is pretty stiff, and is flattened at the sides; the body is short and thick; and the dorsal ridge in the skeleton slopes somewhat backwards from the shoulders, but in the living animal this is concealed by a large hump or two humps of fat. The short thin tail has a tuft at the end. The thick legs, much swollen at the joints, appear as if they were badly inserted in their sockets. They end in broad padded soles which are round behind and cloven in front, where the two short triangular hoofs are placed. The hindlimbs appear as if they were dislocated. When the camel is resting it lays itself down

exactly like a frog ready to spring. On the fore-knees there are callous protuberances on which the animal supports itself in lying down.

The rather long brain-case with curved nasals has a strong ridge running along the middle line, and connected behind with two transverse side ridges in such a manner as to inclose on each side a broad space in which the strong temporal muscles are attached. The dentition presents certain characteristic marks. In the adult animal there are in each half of the upper jaw three canine-shaped teeth set close together; they are all sharp-pointed, cutting, and a little recurved. The first of these teeth, which is set in the premaxillary bone, is an incisor; the second, the largest of all, is the canine; the third is the first premolar. A not very large gap follows, and then comes the series of cheek-teeth, the first two of which are premolars with simple half-moon-shaped lamellæ, while the others are true molars with lamellæ placed in pairs. In the lower jaw the relative situations of the different sorts of teeth are the same. The three pairs of incisors, which are rather prominent, are placed at the end of the rather long narrow jaw in a segment of a circle, and they are immediately followed by strong recurved canines, next to which come a pair of curved premolars, which are flattened at the sides and sharp. A wide interval separates this series from the back-teeth, of which there are only four on each side.

The structure of the stomach is extremely interesting. On the rather large paunch are to be seen two large swellings, which consist essentially of more than 800 large cells arranged in parallel rows and separated by membranous partitions, in which the muscular tissue is so beautifully developed that it forms true sphincters capable of closing the mouths of the cells, which are more or less filled with water. This considerable store of fluid in the stomach, a store which the camel eagerly



To face page 130.

PLATE XXXIV. — THE DROMEDARY OR COMMON CAMEL (*Camelus dromedarius*).

renews when the opportunity presents itself, enables it to go for several days without drinking, and that too even in the glowing deserts which it inhabits. The third stomach, the *liber*, on the other hand, is undeveloped.

We are not acquainted with any camels living perfectly wild. The animals belonging

to Central Asia which have been described as such are probably only escapes from domestication.

Two species are usually distinguished, the two-humped or **Bactrian Camel** (*Camelus bactrianus*), fig. 199, which is confined to Asia, and in particular Central Asia north of



Fig. 199.—The Bactrian Camel (*Camelus bactrianus*).

the Himalayas; and the single-humped camel or **Dromedary** (*Camelus dromedarius*), Pl. XXXIV., which is found tame throughout Africa and Asia Minor. Both species are illustrated in this work.

These two so-called species are distinguished only by their humps, those accumulations of fat, which are very variable as regards their volume. The state of health of the camel is held to be indicated by the condition of this hump, which in well-nourished animals is large, full, erect, and elastic when touched, but in ill-fed, starved, or diseased animals hangs down, and is sometimes scarcely observable. Apart from this feature no dis-

tinguishing mark can be pointed out between the two species; and we may add that the numerous breeds which have manifestly been produced by artificial selection by man present far greater differences as regards the proportions of the limbs, the structure of the skeleton, the character of the hair-covering, and so forth, than the two species described.

It is true that the two-humped camel is heavier, its body more thickset, its hair-covering denser and coarser, especially on the head, the shoulders, and round the hump; but it must be borne in mind that this animal, as an inhabitant of the steppes of Central Asia, where it is employed in various ways

by Turkomans, Mongols, and Kirghiz, has to endure very severe winters, that much less care is bestowed in selection than in the case of the dromedaries; and, finally, that it is employed almost solely as a beast of burden in the trade between China and the countries of the West. Manifestly the Bactrian camel is the original breed. It is said that north of Tibet there are animals which have become wild, but we have no precise and trustworthy accounts of these. It is certain that the camel is originally a native of Asia; that the Semites, for whom it is a necessary condition of life at the present day, were not yet acquainted with it in the earliest antiquity; that it was nevertheless introduced into Egypt 1400 years before the beginning of the Christian era; that mention is made of it at the very commencement of the Bible narrative, that the Egyptian name for it is the same as the Hebrew, the name from which the word camel itself comes, and that the Semites introduced it into northern Africa and the Sahara, while it already lived in the Soudan in the preceding epoch, from which we have figures of it showing that it was then in Egypt.

But however that may be, it is certain that the word dromedary is unknown to the African tribes, who rear only the single-humped camel; and everywhere in Africa this species is called by the Europeans *camel*, by the Arabs *jammel*. But the latter distinguish several races, some of which, used only for riding on, are known as *meharis*, and compared with animals used to carry burdens are as much more highly esteemed as noble racers are, compared with draught-horses. The mehari, excellent sires of which are reared by the Tuaregs of the Sahara, has very long slender legs, a short-haired glossy coat, expressive eyes, and stands in high repute on account of its fleetness, which surpasses that of the best horses, since the speed can be maintained longer.

The camel is certainly an animal wonder-

fully adapted to a life in the steppes and deserts. The colour of its coat, a yellowish-fawn colour or brown, is suited to that of the ground; only with difficulty can a recumbent camel with its long neck stretched out on the ground be distinguished from a mass of rock. Its moderation as regards food is quite proverbial. In case of need it feeds on the tough spiny plants which the desert produces, and even devours them with delight when incrustated with salt proceeding from the exhalations of the desert. When it is able to feed on fresh juicy herbs it can endure thirst for more than a week.¹ Thanks to its broad callous soles, it runs easily across the glowing sands; and it carries considerable burdens, which, however, must not overtax its strength. It is the "ship of the desert" in the fullest sense of the word, without whose aid the caravans would be an impossibility; and it has this resemblance to a ship also, that it causes sea-sickness in riders not accustomed to it.

[To novices in the art of camel-riding there are other inconveniences attending this mode of progression, which are graphically portrayed in the following account of a camel-journey:—

"We are to mount the ship of the desert. There are several methods of doing this, each of which has its difficulties. The most plausible appears to be to mount while the animal is still crouching on the ground. But we take very good care not to attempt that alone, since, long before we could seat ourselves properly, whenever it felt our weight in mounting, the camel would rise suddenly and fling us backwards and sideways. Any one who is accustomed to riding on a camel knows that quite well, and is able to seat himself firmly at once. We uneducated folks, however, while mounting and gradually trying to settle ourselves in our seat, cause the driver to tread upon the forefeet of the still squatting camel so as to keep them from moving, or to tie them, and fix one hand upon the bar of the compressing apparatus that projects before the saddle. It is only in this way that we can prepare ourselves for all the changes of our centre of gravity

¹ Mr. F. L. James, in giving an account of a journey through the Somali country, speaks of camels that had gone fifteen days without water. See Proc. Roy. Geog. Soc. 1885, p. 630.—Tr.

that we have to undergo. We give the driver a signal to release the animal, and our body is now swung in rapid succession backwards, forwards, and again backwards; for the animal first springs up with the lower part of the fore-leg (it is far more willing to do this than to kneel), then brings its hind feet, on the stretch, into play, and rears at last quite upright, while it now raises the lowest portion of its fore-legs, and stands upon the sole.

"We now find ourselves high above the ground, higher than we have ever ridden before; we shudder when we think upon our helpless condition. If the animal were to become refractory what could we do? We sit far too high to be able to steady ourselves with the calves of the legs as in riding on horseback. If we sit astride upon the broad saddle, our soles scarcely touch the ribs; if we seat ourselves, as is the common plan, with our feet dangling down over the neck or over the side of the animal, our position is indeed more comfortable, but is less secure should the awkward case occur in which both saddle and rider are flung off by the violent movements of the camel. The bridle is of no use, since the cord brought round its nose has little influence on the beast however hard it is pulled. The Moslim merely cries, "The name of God on you" (*Bismillah Alek*), when it turns restive or refractory. Such misbehaviour on the part of the animal is fortunately rare, however; were it not so other means of subduing it would have been discovered before now. During its ordinary running pace we are in the greatest security.

"We find that the angular projections of the wooden part of the saddle on which any part of the body rests are still insufficiently padded, so that we cannot endure to ride for a quarter of an hour, and have to request the driver to let us dismount. He warns us to stick on firmly as in mounting, since the backward and forward shakings are the same, only they occur in reverse order. We can also dismount from a standing camel by grasping the projecting bar of the saddle with one hand and sliding down by means of the other on the sloping hind-neck. On remounting, after our seat has been improved, we employ the second method for a change. The camel stands, we grasp with one hand that important saddle-bar, the driver forms one step with his back or his hand, the hollow of the animal's neck forms a second, and this being reached we climb as gracefully as we can into the saddle. It is certainly still better to emancipate oneself entirely from the driver, to compel the camel to lower its

neck, and to get the knee upon this by swinging oneself up with one hand on the saddle-bar, whereupon the animal itself raises both neck and rider, who can now obtain full possession of his seat. During the latter operation, however, the animal is again on the march, which makes turning oneself somewhat difficult. A person should likewise learn to make the animal let him down when travelling along, and how to bring it to the trot, and also how to dismount when on the march. But this belongs to the higher branches of the riding art; we are glad if we can mount and dismount in any manner without damage."—*Upper Egypt*, by C. B. Klunzinger.]

The senses of the camel, except that of smell, are obtuse. Their scent, however, is keen enough to guide thirsty animals to water at a distance of several miles. The character of the camel has been very variously estimated. The natives of the East in general exaggerate its good qualities. The Europeans overwhelm it with all kinds of denunciations. To me it appears, when I combine all these different estimates with my own observations, that the camel, like so many other domestic animals, has come to share the character of its masters; it is frugal, patient, and peaceable till the moment when the passion of love comes into play. To all that one tries to get it to do it offers a blind stubborn resistance, accompanied with a deafening bellowing, but at last submits with a patience proof against any trial. Sometimes it is cunning and mischievous, generally it yields only to force, shows no attachment to its keeper, and surrenders itself to all the consequences of his actions with passive subjection. To the European, to whom time is money, these qualities are in the highest degree irritating and distracting; for the Oriental they are only the reflex of his own mode of action. The camel avenges itself for the bad treatment to which it is subjected by all kinds of tricks, which are sometimes contrived with devilish cunning; but except during the breeding season, when it becomes intractable, it submits in the end and does all that its master imposes on it, so far as its strength allows.

Attempts have been made to introduce camels into other countries besides those in which they are already found, and a stud has existed at San Rossore, near Pisa, for about two centuries, but hitherto it has not rendered any great services. Camels manifestly require the great plains with dry climate, the

steppes and deserts, and they will prosper in Australia.¹

The Llamas.

The **Llamas** (*Auchenia* (*Lama*)) belong to South America, and are seen at the first glance to differ considerably from camels,



Fig. 200.—The Llama (*Auchenia Lama*).

through being of smaller size, having no hump, and having slender legs. They likewise differ in having the feet more deeply cleft and the callous pads less developed. The tail is short and rudimentary, and the hair long and thick, which caused the first conquerors of South America to look upon the llamas as sheep. But with respect to the bodily structure there are no other differences besides those which relate to the slighter build of the llama. The dentition, however, is so far different, in that the first premolar, which adjoins the rather sharp recurved canines, is shed at an early period of life, and the interval between the can-

ines and the back teeth is thereby rendered greater.

Of these animals we know four species, two of which, the **Guanaco** and **Vicuña**, are still found in the wild condition, while the other two, the **Llama** and **Alpaca**, are completely domesticated. They were already subject to man at the time of the conquest. Although all these animals are essentially inhabitants of the mountains, and in particular of the Cordilleras, yet some of them also descend to the plains and live there in considerable herds.

¹ Camels have often been employed in exploring the interior of Australia, and are now reared in the colony of South Australia, where they are regularly made use of in the conveyance of stores into the interior, and for other purposes.—TR.

The **Guanaco** (*Auchenia huanaco*) has the form of a large fallow-deer, and lives both in the plains of Patagonia, where the herds, led by an old male, readily associate with the rheas or South American ostriches, and in the Cordilleras, where it climbs like a goat. Its general colour is a dirty reddish-brown; the under parts are whitish, and so also are

the inner sides of the legs. The coat consists of a fine wool with longer hairs interspersed. The guanaco has been tamed in the mountains; in the plains it is only hunted, and always on horseback. It is caught by means of the bolas, that is an apparatus consisting of two balls attached to a long strap or thong, which, after being swung round the head, are



Fig. 201.—The Alpaca (*Auchenia Paco*).

thrown at the animal so as to entangle the legs.

The **Llama** (*Auchenia Lama* (*Lama peruviana*)), fig. 200, a domesticated form descended in all probability from the guanaco, which it resembles in form and proportions. In relation to colour all sorts of varieties are met with: brown, yellow, red, black, white, and often even spotted examples. The llama is the camel of the Cordilleras, and as a beast of burden serves to carry on the trade across the mountain passes between the mines and the sea-coast. It can carry one hundredweight at the outside. It runs and climbs well, but cannot accomplish any great distances; when loaded, at the most thirteen or fourteen miles in a day. The llamas are gentle creatures,

but require to be humanely treated. The only resistance which they offer to violence is to squirt their disgusting yellow spittle in the face of their tormentor. When well treated they are extremely docile. The hair is coarse and can be used only to make string. The flesh, especially of young fattened animals, is good.

The **Alpaca** (*Auchenia Paco*), fig. 201, is smaller than the preceding species, has thinner legs, and a splendid coat of long soft wool. The alpacas are kept in great herds on the mountain plains, where they are not nice as to their food. Once a year they are collected with infinite trouble into larger herds in order to be shorn. The wool, as every one knows, is highly esteemed, and the flesh

is excellent. To catch the animals one must always resort to a kind of chase; they are as obstinate as mules, and when separated from the herd throw themselves down on the ground. Their colour varies like that of the llama, which is always a sign of domestication. As beasts of burden they are not used at all.

The **Vicuña** (*Auchenia vicuña*) is found only at the height of 13,000 feet and upwards

on the Cordilleras of Ecuador, Peru, and Bolivia. This species is the smallest and the slenderest. A remarkably fine and highly esteemed woolly fleece covers the animal like a sheep. Head, neck, rump, and thighs are of a reddish-brown colour, the other parts are white. The animals live like wild goats or sheep, like these too are agile and good climbers, and they are eagerly hunted on account of their wool and very palatable flesh.

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE EVEN-TOED UNGULATES.

The geographical distribution of the even-toed ungulates presents two peculiarities to which we have already had occasion to call attention, namely, on the one hand cases of very restricted localization, and on the other hand cases in which the range is extraordinarily wide.

The hippopotamuses are entirely confined to the African continent, where their domain is constantly getting more and more restricted. The small species has been found in the republic of Liberia, the large still existed in historical times in the Lower Nile (in Egypt) as well as in the streams of the Cape region, whence it has entirely disappeared. It is still abundant and wide-spread in the interior of Africa. In the Quaternary period hippopotamuses even existed throughout Central Europe and extended to England.

The **Hog** family has two entirely distinct territories. The **Peccaries** are characteristic in South America, and range as far north as Texas. Before the introduction of the domestic pig the hog-type was wholly unrepresented in the north of America. The **Wart-hogs** and the **River-hogs** are exclusively African types. The **Babirussa** is confined to the islands of Celebes and Buru, accordingly to the confines of the Indo-Malayan

and Australian regions. The true **Pigs** are distributed over the whole of the Eurasian continent, as well as over the Mediterranean region, which was formerly separated from the African continent, and over the islands of Asia as far as Japan and New Guinea. Perhaps there are also members of the group in Central Africa, but hitherto the evidences adduced in favour of this view are not quite convincing.

The **Tragulida** have a highly peculiar distribution. The genus **Hyaemoschus**, resembling the pigs, is found only in West Africa, while the true **Chevrotains** exist only in India up to the foot of the Himalayas, and on the Sunda Islands.

The **Musk-deer** inhabits Central Asia. Its limits are the Himalaya Mountains, the mountains of Siam and Tibet in the south, and the Altai Mountains and the banks of the Amur in the north.

The **Deer** family is distributed over the whole earth, with the exception of the greater part of Africa and the whole of Australia, from which great island the placental mammals generally are almost entirely excluded. With the exception of some northern species, such as the elk, the reindeer, and the stag, all the American species are different from

those of the Old World, but the forms belonging to the two sides of the ocean show a certain parallelism. It may be presumed that the three forms mentioned reached North America by migrating from the Polar regions.

The **Hollow-horned Ruminants** are altogether absent from South America, and are but feebly represented in the northern division of the continent. The curious forms of the Rocky Mountains, the pronghorn antelope, the big-horn, and the white goat, together with the musk-ox, are the only characteristic forms of North America. The American bison approaches too closely to that of the Old World for us to be able to consider these two forms as anything else than varieties descended from the same species, which has immigrated into both continents from the Polar regions. In the Old World the **Goats** and the **Sheep** appear to be exclusively of Eurasian origin. The Barbary wild sheep makes only an apparent exception; the Mediterranean zone forms, in fact, a whole by itself, which belongs to the Palæozoic region. On the other hand, the big-horn of the Rocky Mountains might perhaps be only an immigrant from the opposite peninsula of Kamchatka. **Oxen** and **Antelopes** inhabit the whole of the Old World. These two groups present in part very characteristic genera and species for the two continents of Eurasia and Africa. Among the antelopes, for example, the saiga and the chamois for Europe and Asia, the gnus for Africa, among oxen the yak and anoa for Asia, while other groups are found everywhere in the Old World, though almost entirely absent in the New, for North America possesses only the forms already mentioned and South America none at all.

The **Giraffes** are exclusively African types. The **Llamas** are confined to South America, and the **Camels** belong originally to Central Asia, whence they have been introduced into Africa.

The present geographical distribution of the Artiodactyla differs widely from that which immediately preceded in the Quaternary period, and corresponds exactly to the facts from which palæontologists have inferred certain lines of descent.

In comparing the faunas of the Quaternary period with the present distribution we observe remarkable transpositions in two opposite directions, and in connection with that fact we have to note some rather striking instances of the extinction of certain species. Let us now, then, examine the various groups from this point of view, and trace them out to the point where their characters become clearly prominent.

In the Quaternary period the **Hippopotamuses** inhabited the rivers of Southern and Central Europe, and extended as far as Ireland. A larger species than the present hippopotamus (*Hippopotamus major*), but otherwise very little different, lived within these wider limits, while in Sicily and the valley of the Arno has been found a species (*H. minor*) which was no larger than a pig, and may have been more closely allied to the hippopotamus of Liberia. Now still older hippopotamuses have hitherto been found only in Algeria in the Pliocene, and in India in the Miocene of the Sewalik Hills, where there existed hippopotamuses with six incisors and poorly developed canines, and in addition to these a genus, *Merycopotamus*, which through the structure of its skeleton and its dentition forms the transition to the pigs. At the present day there are no longer any members of the family in India. This new type, for it is new, since it appears first in the Upper Miocene, must accordingly have migrated from its home to its present African domain after it had peopled a part of Europe in the Quaternary period.

The **Hog Family** shows two parallel primitive stocks of much greater antiquity, the one belonging to the Old World, the other to America. True **Pigs** (*Sus*) are found already

in the Middle Miocene, and a series of very closely allied genera can be traced through the preceding strata until we arrive at the two-toed genera *Entelodon* and *Chærotherium*, belonging to the Upper Eocene, and the four-toed genera, *Chæropotamus* and *Hypopotamus*, of the Eocene gypsums of Montmartre. The pigs accordingly belong to a very old stock, the stages in whose development we can follow without interruption down to the forms now existing. No fossil forms have yet been found, however, representing the babirussa, the wart-hog, or the river-hogs.

A quite different series is presented by the American peccaries. "We appear," says Marsh, "to have in the series of genetic forms comprised between the *Eohyus* of the Lower Eocene and the peccaries of our own time (*Helohyus*, belonging to the Middle Eocene; *Perchærus*, to the Lower Miocene; *Thinohyus*, to the Upper Miocene), the line of descent terminating in the typical American *Suidæ* of the present day. Extinct genera are already found in the Quaternary period, for example, *Platygonus*; but at that time the peccaries extended to the northern boundary of the United States, whence they have since retreated." I insist on the difference in the primitive stocks on the two sides of the ocean since Eocene times. "Whatever may be said of them," Marsh continues, "so much is certain, that no authentic remains of the genera *Sus*, *Porcus*, *Phacochoerus*, or *Hippopotamus*, which constitute the group of the *Suidæ* in the Old World, have ever been found in America."

On both sides of the ocean the old bunodont *Artiodactyla* of Eocene times had four toes on the feet. The reduction of this number has gone on during the further development of the type, but has not been completed; it has stopped short in the peccaries at the stage indicated. That the peccaries are the forms which approach most closely to the ruminants of all the hog family has already been mentioned.

In the series of the selenodont ruminants we have to take note of analogous facts. With reference to these also we may without fear of contradiction maintain the proposition, that we find two entirely different stem-lines on the two sides of the ocean. These arise from genera belonging to the Middle and Lower Eocene, in which the characters derived from the dentition and the structure of the feet are still not well pronounced, inasmuch as the cheek-teeth exhibit, so to speak, wavering forms between bunodont and selenodont types, the number of the incisors begins to be reduced, and the four-toed feet, by continuous reduction of the lateral toes, become by degrees two-toed. It is only in later epochs that we begin to obtain characters derived from antlers and horns. It may be taken as a general rule that these outgrowths are only late products, and that the original ruminants were without them, as the young animals are still. The fact that horns and antlers do not appear till long after birth is in itself enough to show that these appendages are of recent acquisition.

The transition from these equivocal and variable forms, which Leidy has characterized as "ruminant pigs," is effected principally, as Kowalewsky has shown, by the disposition of the bones of the wrist and ankle (*carpus* and *tarsus*), which get arranged in two vertical series in such a manner that each series corresponds to one of the principal toes and so helps to carry the weight of the body, while the forms in which this arrangement does not take place remain unfruitful and cannot be continued in the direct line of the present ruminants.

In the Middle and Upper Eocene are found a number of these forms, whose teeth already show the half-moon-shaped folds, but which still retain the full number of incisors in the upper jaw, and which, moreover, sometimes have very strong canines. In many of these the lateral toes are greatly reduced, although the wrist and ankle still retain the unfavourable

condition above described. Such forms are *Hyopotamus*; *Anoplotherium*, examples of which are so abundant in the gypsums of Montmartre; *Xiphodon*, whose canines resemble those of the musk-deer; the four-toed genus *Dichobune*, some species of which did not exceed the size of a hare. In America the corresponding genera are present in enormous quantity in the Eocene strata; *Eomeryx*, *Opomeryx*, and *Oreodon* represented in the New World the ruminant pigs.

The first true ruminant in Europe is the genus *Gelocus* belonging to the Upper Eocene. It was about the size of a dog, but cannot be assigned to any particular family.

The *Tragulida* first appear as represented by the still-existing genus *Hyæmoschus*, remains of which have been found in the phosphorites of Quercy in the west of France, that is, in the Upper Eocene, and in the Middle Miocene of Sansans. This genus accordingly lived in Europe at the same time as the prosimian genus *Necrolemur* so closely resembling the African pottos, which has been found in the same phosphorites; and it is curious to note that these two genera are now both confined to the west coasts of Africa, while their ancestors lived in Europe.

Deer and fully characterized *Antelopes* appear at the same time in the Middle Miocene strata of Sansans and St. Gaudens. The old deer have forked horns, which in certain respects are like those of the muntjac and the pronghorn of the Rocky Mountains. Only in the Upper Miocene and the Pliocene do we meet with antlers with several tines; antlers have thus passed through the same course of development in the geological epochs as they pass through in our stags in the course of life. Yet this family shows the greatest development of the antlers during the Pliocene and Quaternary period; *Cervus Sedgwickii* from the forest bed of Cromer had gigantic antlers, and still more gigantic were those of the *Megaceros* from the peat-bogs of Ireland. The latter species, standing

as regards its horns between the fallow-deer and the elk, was distributed over all central and southern Europe. Whole skeletons of it have been found in the peat-bogs of Ireland, and there is no doubt that these gigantic deer were hunted by man. During the ice-age the elk and reindeer were spread over all Europe north of the Alps and the Pyrenees. The reindeer first retired within the Arctic circle; it did so even in prehistoric times, and it was only in the middle ages that it was followed by the elk.

The *Antelopes* are as old as the deer. Their remains are found in the Upper Miocene of Pikermi, Mont Leberon, and the Sewalik Hills, and in such quantity that it is plain that in those times numerous herds of these animals must have roamed over southern Europe as well as India. Some of the species then living approached the gazelles, others the cannas and the Oryx. The saiga has had its former domain restricted like the elk. During the Quaternary period it was spread over the plains of central Europe up to the foot of the Pyrenees.

The *Oxen* are apparently descended from the antelopes. The oldest forms are the buffaloes from the Sewalik Hills. The bisons first appear in the Quaternary period in the form of an intermediate species which is to be placed between the European and American bison. Ancestors of the true oxen are found in the Pliocene strata of Italy and Asia; in the Quaternary deposits they are very numerous. Goats and sheep can be distinguished by the structure of their skeleton, the only means of distinction accessible to palæontologists, neither from one another nor from certain antelopes. Unquestionable remains of members of these two groups are first found in Quaternary strata. The highly remarkable intermediate form of the musk-ox, which at the present day is confined to the Polar regions of North America, still inhabited during Quaternary times the north of Germany and France.

The family of the **Giraffes** appears for the first time, represented by an actual giraffe, in the Miocene strata of Pikermi. This type accordingly then inhabited Europe. But at Pikermi, as well as in the deposits of the Sewalik Hills, which are perhaps a little older, there are preserved also some gigantic forms which are unquestionably allied to the giraffe, and some of which must have been very clumsy and unwieldy creatures; such, for example, are the *Helladotherium* of Pikermi, the *Sivatherium* and *Bramatherium* in India. These forms are extremely curious, and *Sivatherium*, for instance, had a skeletal structure as heavy and clumsy as that of a *Rhinoceros*.

The **Camels**, finally, are traced back in the Old World to the Miocene of the Sewalik Hills.

The primitive stocks have developed in America in a manner generally analogous to what we find in Europe, but differing in the details. In this part of the world no fossil remains have yet been found of giraffes, goats, sheep, antelopes, or true cattle; and these groups are likewise absent from the fauna of the New World, except the goat,

the sheep, and the pronghorn of the Rocky Mountains. The bison date there from the Pliocene; and during the ice age the musk-ox ranged over the whole area of the United States.

The **Camel Family**, on the other hand, has a much older line of descent in America than in the Old World. This line plainly begins in the Upper Eocene with a genus *Parameryx*. It gets more and more sharply characterized in the Miocene and Pliocene, and even in the Quaternary period the llamas inhabited the whole area of the United States, whence they have since retired.

The **Deer** finally show the same gradual development of the antlers as in Europe. They begin in the Lower Pliocene with genera (*Casoryx*), which have the metacarpal and metatarsal bones still separate, and are continued without interruption till we come to the types of the present day. In the Quaternary period the reindeer advanced as far as Texas.

Lastly, we mention that it has been alleged that antelopes have been found in the caves of Brazil, but a careful investigation is required for the establishment of this fact.

GNAWERS OR RODENTS

(RODENTIA).

The Rodents have claws on the toes (*Unguiculata*) and an incomplete dentition. They have only two large functional incisors, without roots, above and below; there are no canines; the cheek-teeth, all nearly similar in form, stand in a close-set series beside one another, and are separated from the incisors by a wide interval. The placenta is discoidal.



The *Rodents* or *Gnawers* are the order of mammals richest in genera and species. It is an order, the members of which vary in an extraordinary degree through the diversity of secondary characters arising from adaptations to different modes of life, and yet are best marked off from other orders by the constancy of their essential characters. The internal structure, on the description of which we cannot here enter, is little different from that of the insect-eaters, and certain details even remind us of the marsupials.

The rodents are in general small animals; the largest of them, the Capybara, does not exceed in size a one-year-old pig. On the other hand, the smallest rodents rival in diminutiveness the pigmy shrew or shrew-mole of the Irish. With respect to the external characters we may observe a certain parallelism to the insect-eaters, with which the rodents also agree in the simple structure of the brain as well as in the peculiar formation of the sexual organs.

The dentition presents the chief distinguishing character, that in which there is but little variation, and in which there is an essential difference from the insect-eaters. In the latter the form, number, and position of the teeth are remarkably varied, while in

the rodents we must enter into the details of structure to find any distinctions at all between the different types, and even then they are not profound.

The long-drawn-out jaws have only four incisors altogether, one in each half of each jaw. These incisors have no roots, and consequently keep growing throughout life. They are deep-set in large sockets, which are continued far backwards, and are always curved in the arc of a circle. The enamel layer, often yellow or red in colour, is found only on the outer surface. Sometimes they show longitudinal folds. Since the condyle or articulating surface of the lower jaw is drawn out in the direction of the axis of the skull, and the gnawing action takes place through backward and forward movements of the jaw, these teeth get worn away on the back by mutual friction in such a manner that the enamel layer always presents a chisel-shaped cutting edge transversely placed. The marks which are left, for example, by the teeth of a beaver on trees cut down by them, resemble the marks of a chisel so much that it has often been a matter of controversy whether certain marks found on fragments of timber that have come down from prehistoric times are to be ascribed to the hand

of man or to beavers. Since these incisors go on constantly growing, remarkable malformations can be produced in captive animals by preventing them from using these teeth. Only in a single family, that of the hares, do we find behind the large functional incisors a pair of small incisors, which are so placed that they seem to serve as a heel to the former.¹

The canines are altogether wanting even in the milk-dentition.

The number of the cheek-teeth is rather small, varying from two to six in each half of each jaw. They resemble each other very closely, so that the premolars cannot be distinguished by their form alone from the true molars. If, however, we trace out their development, we find that there are always three true molars, and that the teeth standing in front of these are liable to be shed. But in certain rodents, for instance, it has been observed that the milk-teeth are shed even before birth, so that these species come into the world with the permanent dentition. The rodents with three molars do not get their single premolar replaced, whether it be shed before or after birth; those with four molars have a single premolar replaced, and thereby present a remarkable point of agreement with the marsupials, which also have only one replaceable tooth in their dentition. Lastly, the rodents with five molars have two replaceable premolars.

The structure of the cheek-teeth, although it varies greatly in details, may be reduced to a few types, which, however, are connected by intermediate forms. We find in the first place rootless constantly-growing cheek-teeth in which the part set in the socket is wide open below, but otherwise resembles the crown in form. Such is the case, for example, with the *Capybara*. Secondly, we see teeth with clearly-distinguished crown and root, as in the rats. But between these extremes there are transitional forms with a more or

less complete closure of the roots, and we even find genera in which the distinction between root and crown first comes out in advanced age; the root in the young animal is open and gets constricted only with advancing years.

The relations between the different substances which compose the cheek-teeth, enamel, dentine, and cement (if the last is present at all), vary considerably, and have been made the ground of important zoological distinctions. In some, for example the *octodonts*, the cheek-teeth are simple cylinders exhibiting a round or oval surface filled with dentine and surrounded with an unbroken ring of enamel. These teeth resemble those of certain *edentates*. In others again the teeth are tubercled, and accordingly in a certain measure similar to those of the *Omnivora* or *Insectivora*. As the tooth gets worn away the tubercles form small isolated patches surrounded by enamel. Such teeth are found in the rats. Vertical enamel folds producing grooves on the outside penetrate more and more deeply into the dentine. If there is, as in the jumping-hares, only one such fold, the worn surface presents a figure like that of a loaf of bread divided by a single groove down the middle. If there are two folds, an outer and an inner, the tooth appears to consist of two halves connected by a bridge, and when these folds curve and wind, as in the beavers, the gnawing surface presents a confused coil of folds, which produces the appearance of a piece of coarse cloth irregularly folded and pressed. Lastly, the folds may, as in the *Capybara*, pass right across the teeth and thus become subdivided into a number of plates or *lamellæ* connected by cement and having the intervals between them filled with dentine, so that these teeth, which resemble those of elephants, seem to be made up of a number of small teeth pressed close together. There are, accordingly, among the rodents, simple, tubercled, folded, and lamellar teeth.

¹ On this account this family is sometimes separated as a distinct sub-order under the name of the *Duplicidentata*.—Tr.

We do not mean to discuss here the characters drawn from the skeleton and the nature of the internal organs, but confine ourselves to the following remarks. The limbs present considerable differences according to the uses to which they are adapted. Those rodents which use their fore-feet as hands to hold their food while they gnaw, as well as those which climb, swim, and burrow, always have a collar-bone, while this bone is rudimentary or altogether absent in those which use their limbs only for running. The toes are almost always free, seldom connected by a web for swimming. In most cases they are furnished with more or less sharp claws. But there is a South American family, to which our guinea-pig also belongs, provided with true hoofs, whereby it is proved that the distinction between Ungulata and Unguiculata, to which so much consequence has often been attached, is after all of doubtful value.

Lastly, we direct attention to a singular fact first observed in guinea-pigs, but also verified in rats and mice. In all other known mammals, and even in other rodents, as the rabbit, the embryo is formed in such a manner that the central nervous system, which occupies the back, is turned towards the outer part of the egg, the yolk of which is enveloped by the abdominal side of the embryo; but in the species named the position is exactly the reverse. We now know the cause of this inversion, which at first appeared an inexplicable anomaly; but, nevertheless, when we observe this phenomenon occurring in species separated by the whole breadth of the ocean, we cannot cease to regard it as striking.

Altogether the rodents form a well-defined order, constituting, as we shall see, one of the oldest types of placental mammals. It cannot be denied that it presents certain affinities to the insectivores and even to the marsupials, and it is, moreover, clear that the dentition of the aye-aye, on the one hand, and the hyrax on the other hand, indicates

very well the manner in which the peculiar dental structure of the rodents has been brought about by the loss of the lateral incisors, the canines, and some of the premolars; yet it must also be granted that these modifications of the dentition are very old, and that the affinities that may have existed, either with other placental mammals or with the still older marsupials, are very obscure and difficult to demonstrate.

It is likewise impossible to say anything general concerning the habits and mode of life of the members of this order. They have, indeed, become adapted to all modes of life, to all the conditions which all the different parts of the globe, with all their varieties of climate, present. The Torrid and the Frigid Zones, mountains and plains, withered steppes and soft marshes, are inhabited by them. Wherever vegetable or animal life of any kind is found at all, rodents of some kind are to be met with; in the water and under the ground as well as on the surface. Everywhere we find them exposed to a violent struggle for existence, pursued and preyed upon by carnivorous animals of all classes—mammals, birds, reptiles, and even fish, and from these struggles we always see them come forth as victors, not through bodily strength or cunning, but through their incredible fertility. Only a few of them are provided with means of defence, for example, the porcupines, and these bring forth but few young, and have a long period of gestation. But in the case of the great majority of rodents, and especially the small species, the females bring forth a considerable number of young ones, which complete their development in a comparatively short space of time, and soon become capable of reproducing their kind. In this manner the rodents, if the conditions are otherwise favourable, multiply with extraordinary rapidity, and in this fact we find the explanation of their frequently sudden appearance in innumerable swarms, which, like swarms of

locusts, overwhelm the land and leave destruction and desolation behind them. Their enemies also multiply rapidly indeed, but are helpless in face of such prodigious swarms, which always leave enough to continue their species.

THE SQUIRREL FAMILY

(SCIURIDA).

The family of the squirrels comprises a pretty large number of forms, which vary



Fig. 202.—The Taguan or Brown Flying-Squirrel (*Pteromys ptaurista*).

between the two extremes presented by our ordinary squirrels, the agile climbers, and the sluggish clumsy marmots, which live almost entirely underground. But the intermediate forms are so numerous that it is impossible to break up this family into any subdivisions. It is characterized as a whole by the structure of the teeth, the skeleton, and the feet. In the upper jaw there are usually five, in the lower, four cheek-teeth, with triple or quadruple roots and triangular crowns; the internal heel and the division of the tooth into external

points present the \triangleright -form so characteristic of the insect-eaters. In the majority these cheek-teeth retain more or less sharp peaks and tubercles even when worn, but others have the grinding surface flattened by use so as to present more or less complicated folds. The first upper cheek-tooth is small and in some species is soon shed. In the skull we are struck by the longish nasals, which become broad at the end so as to support the blunt snout. The frontal bone carries a considerable process, which forms in the rear

a boundary between the cavity of the orbit and the temporal fossa, without, however, forming a complete ring round the former. A collar-bone is always present, an indication of the fact that the fore-limbs are capable of varied applications; they can, in fact, be used as arms and hands. The feet have always four free toes in front, five behind, and these are armed with strong, sharp, curved claws; but there is always at least a rudiment of the first digit more or less well-developed. The squirrel family is distributed over the whole earth with the exception of Australia and Madagascar.

According to their mode of life the members of this family may be considered as forming two groups, the climbing squirrels and the crawling marmots. The typical members of the former group live chiefly on trees.

The Squirrels.

The **Flying-Squirrels** (*Pteromys*) are distinguished by the parachute, formed of a fold of skin stretched out between their limbs, neck, and tail, as in the colugo or flying-cat. By means of this hair-covered parachute they can make extraordinary leaps. A bony spur proceeding from the wrist serves as a support for it. In other respects they are true squirrels, with round heads, elegant limbs, and a tail which is in some cases round and bushy like that of a fox, sometimes set with two lines of hair as in the ordinary squirrels.

VOL. II.

The small ears are not tufted. In habits they are nocturnal. During the day they sleep in holes in the trees, where they build warm nests for themselves. In the evening they awake and go out in search of food, not only collecting fruits, nuts, and berries of all sorts, but also catching insects and birds. Like



Fig. 203.—The Common Squirrel (*Sciurus vulgaris*). page 146.

our squirrels, too, they are unsparing plunderers of nests, and know well how to suck out the contents of the eggs, which they hold gracefully in their fore-paws. Like all nocturnal animals they are, when kept in captivity, sleepy and inactive by day, and, when teased, ill-tempered, but at night extremely lively and agile. The larger species are rather vicious, and their sharp narrow incisors inflict deep wounds. The flying-squirrels are

found in the East Indies, on the Sunda Islands, and in the northern part of both hemispheres. A markedly divergent genus (*Anomalurus*), with a dentition allied to that of the porcupine and a tail covered with scales at the base, inhabits the west coast of Africa. The largest of the flying-squirrels, the **Brown Flying-Squirrel**, the Taguan of the Malays, the Oral of the Coles (*Pt. petaurista*), fig. 202, attains the size of a cat, while the smallest, the Assapan of the red-skins (*Pt. volucella*) has a body less than 6 inches in length with a tail of about 4 inches.

The **True Squirrels** (*Sciurus*) form a genus extraordinarily rich in species, found wherever woods exist in the parts of the earth above

indicated. As the type of this genus an illustration is given of our **Common Squirrel** (*Sciurus vulgaris*), fig. 203, a charming creature, just as pretty as it is destructive, in captivity very entertaining when young, but ill-tempered and apt to bite when old. Its bites are deep and leave ugly scars behind. Every one, no doubt, is acquainted with this rodent, which, like all species belonging to the same genus, has a roundish head with two large eyes and enormous ears covered with hair ending in a long bunch of stiff bristles. The body is slender, the long tail thickly covered with hair arranged in two rows. The limbs are rather short, and have in front four well-developed toes and a warty protuberance in place of a thumb, while there are five toes behind. All these toes are free and armed with sharp curved claws. Our species has a coppery-red coat, inclining to brown or yellow on the back, but on the under surface always yellowish. In winter the colour becomes paler. There are also black varieties, more rarely white or spotted ones.

The squirrel lives chiefly on trees, and feeds on seeds, nuts, young shoots, and the bark of trees when filled with sap, and often does much damage to young plantations. The cembra pine, that beautiful tree of the high elevations, can hardly thrive in the Alps because the squirrels greedily search for and destroy their seeds, which resemble pistachios. The squirrel is at the same time a ruthless destroyer of birds'-nests, and is particularly

fond of eggs and young birds. It builds nests for itself in hollow trees, or sometimes among the small twigs growing out from strong branches. The nests are warmly lined, roofed over, and have an opening below directed to the east. The squirrels collect considerable stores of food for winter, and the species living in Northern Siberia undertake great migrations.

The **Ground-Squirrels** (*Tamias*), unlike the last species, live on the ground, and inhabit chiefly the northern parts of both hemispheres. They are smaller and more thickset than our squirrels, have cheek-pouches of considerable size, a shorter and not very hairy tail, and small rounded ears without tufts, but otherwise resemble our squirrels in bodily structure. They dig holes for themselves in the ground.

The species repre-



Fig. 204.—The Chipping Squirrel or Chipmunk (*Tamias striatus*).

sented in fig. 204, the **Chipping Squirrel** (*Tamias striatus*), the **Burunduk** of the Russians, the **Chipmunk** of North America, is only about 6 inches and the tail 4 inches long. A black stripe along the middle of the back and two lateral stripes stand out in relief against the general yellowish hue which forms the ground colour of the fur. This tiny creature, which is detested by the tillers of the ground, digs holes for itself under the roots of trees in the forest, and these holes it fills with acorns, nuts, and grains of corn. It has a winter sleep, but not a very deep one.

The **Spermophiles** (*Spermophilus*) are hardly any larger than the ground-squirrels, and their general habit is exactly like that of

marmots. The body is small and thickset, the tail short, and the ears are almost completely hidden in the fur. They have large cheek-pouches. They inhabit the cold tracts of both hemispheres, dig holes in fields and meadows, and connect their holes by passages. They also collect considerable stores and pass the winter in sleep. The species shown in the illustration, the **Souslik** (*Spermophilus citellus*), fig. 205, is very extensively distributed in Russia, and is also found in the Slavonic provinces of Austria. The fur of this species is reddish-yellow, somewhat lighter on the under parts. The souslik accustoms itself very readily to the presence of man.

The Marmots.

The **True Marmots** (*Arctomys*) have a thickset body, almost equally thick along the whole length, a flat skull, slightly concave between the eyes, and a short tail. There are no cheek-pouches; the ears are hidden in the coarse fur.

The **Alpine Marmot** (*Arctomys marmota*), Pl. XXXV., inhabits the higher regions of the Pyrenees, Alps, and Carpathians between the woods and the glaciers. It is among the larger rodents, for a full-grown marmot has a body about 20 inches in length, exclusive of the tail, which is about 4 inches long. There is a smaller species, called the **Quebec Marmot** (*A. monax*), a native of the Rocky Mountains, and another still smaller, the **Bobak** (*A. Bobac*), a native of the steppes of European Russia, Mongolia, and Siberia.

The Alpine marmot is olive-brown in colour, sometimes very dark brown on the back, but a little lighter on the under parts.

All marmots lead the same kind of life. They dig out underground passages, which are often rather complicated and pretty deep, and these passages end in a chamber vaulted

like a baker's oven, and warmly lined with dried herbs. They collect no stores of provisions, and when they leave their holes it is only with the utmost caution, after they have carefully surveyed the neighbourhood. When they have ascertained that all is safe, they stand sentinel in front of their hole, sitting on their hind quarters with their fore-paws hanging down, and directing their glances all round. Gradually other marmots venture out, the neigh-



Fig. 205.—The Souslik (*Spermophilus citellus*).

bours come together, they play, and devour fresh herbs, berries, seeds, and so forth, but an old animal always stands sentinel. A shrill whistle gives warning of approaching danger, and in the twinkling of an eye the whole assembly has disappeared in their holes, from which they never venture very far. In the autumn the marmots are fat, and, as I can testify from my own experience, very tasty; but since the fat is of a greenish tinge it is rather disgusting to some people. On the approach of the winter's cold the marmot retires to his chamber, after carefully closing the mouth of his hole and the passages with dried herbs, and passes the winter in deep sleep. The chase of the marmot is rather

difficult, because in those rocky solitudes without trees and without shrubs it is not easy to find a cover under which to creep up and surprise the object of pursuit, and unless the marmot is killed at the first shot it escapes at once to its hole. On the other hand, the marmots are very easily dug out in winter if their holes have previously been marked.

The so-called **Prairie-dog** (*Cynomys ludovicianus*), fig. 206, which owes its peculiar name to its voice, which resembles the bark of a dog, is properly speaking nothing but a small marmot, which inhabits the prairies of North America west of the Mississippi. This pretty and amusing little creature is distinguished from the other marmots by



Fig. 206.—Prairie-dogs (*Cynomys ludovicianus*).

the comparatively large size of its first cheek-tooth, by its cheek-pouches, and by the possession of a fully-developed thumb armed with a claw. These prairie-dogs live exactly like marmots, but it is a remarkable fact that in their holes one may often find rattlesnakes and large ground-owls, with which they appear to live on good terms.

THE DORMOUSE FAMILY

(MYOXIDA).

This small family is composed of animals, the general habit of which is not unlike that of the squirrels, but which are distinguished from them by having only four cheek-teeth above and below, these teeth being made up of transverse bars of enamel, and always

having roots. Apart from the structure of the teeth and the form of the skull, which is somewhat elongated like that of the rats, the dormice agree more or less both with the marmots and squirrels. Like the former they pass the winter in sleep, while they agree with the squirrels in their arboreal habits. The fur is soft and woolly, the tail long and thickly haired, except in the case of a few African species. The ears are rounded and have no tuft. The fore-paws have four toes with sharp claws and a small rudimentary thumb covered with a flat nail. On the hind-feet there are likewise four toes.

All dormice build nests for themselves like squirrels. In these they sleep by day. By night they go out in search of food, which consists exclusively of vegetable substances,



To face page 148.

PLATE XXXV. — THE ALPINE MARMOT (*Arctomys marmota*).

especially seeds, small nuts, and the like. Their stomach is incompletely divided into two sections. The large species are remarkably voracious, and, like the squirrels, are ruthless destroyers of birds' nests. In autumn they become very fat, and their winter sleep is not less deep than that of the marmots. Out of three European species the largest and the smallest have been selected for illustration.

The **Loir** or Common Dormouse of the European mainland (*Myoxus glis*), fig. 207, resembles the squirrel most on account of its bushy tail, which may attain the length of 6 inches, almost the same as that of the body. Of the four cheek-teeth the two middle ones are the largest. They have four deep folds of enamel, into which fit three opposite folds.

The head with its round blunt ears resembles that of a rat. The thick silky fur is of a gray colour, inclining more to brown on the back and the tail, which has the hair arranged in two rows. The loir lives chiefly in Eastern and Southern Europe, preferring oak and beech woods for its home. It builds its nest in hollow trees or in holes in the rocks, but never exposed in the fork between two branches like squirrels. It collects stores, and wakes on warm winter days to eat. The Romans prized this animal so highly that they used to keep specimens of it in cages called *gliraria*. The loir is easily caught in traps; and it is very ready to settle in the box-nests which are set up in some districts for starlings and tits. In

captivity the loir is ill-natured; its bites are severe.

The **Common Dormouse**, the Hazel Mouse of the Germans (*Muscardinus* (*Myoxus*) *avellanarius*), fig. 208, is just as gentle and agreeable in its disposition as the loir is ill-natured and disagreeable. It is a charm-

ing little creature of about the size of an ordinary mouse, of a reddish-yellow colour, with a tail about as long as the body, but not very hairy. It frequents shrubberies, and is particularly fond of hazel hedges and thickets; and it advances as far to the north and ascends as high in the mountains as its favourite plant does. The dormouse builds a very artistic round nest, in which it rolls itself up in the form of a ball. It can easily be kept in birds' cages, and it



Fig. 207.—The Loir (*Myoxus glis*).

makes an agreeable pet on account of its cleanliness, its graceful movements, and its gentle and affectionate disposition.

THE BEAVER FAMILY

(CASTORIDA).

The **Beaver** (*Castor fiber*) may well be referred to a separate family, although it is the only species belonging to it. Formerly the beaver was spread over all the temperate and cold countries of both hemispheres. It was so much sought after for the sake of its flesh, its fur, and the castoreum, a product yielded by both sexes and highly prized in medicine, that at the present day it is confined to Eastern Europe, Siberia, Canada,

and the regions lying to the west of the Mississippi. Only here and there, as, for example, on the small islands of the Rhone near Arles, in Bohemia and Silesia, a few specimens are to be found; but elsewhere, except in a few streams in which some lovers of zoology have allowed one or two beavers to live in a state of freedom, the beaver has fortunately been extirpated in the cultivated parts of Europe.

[Among other families of beavers that have been maintained in a state of freedom or semi-freedom by lovers of zoology is one belonging to the Marquis of Bute in the grounds of Mount Stuart, Isle of Bute. Eight beavers had been procured by the marquis in January, 1875, and in September, 1877, the family was visited by the late Mr. Frank Buckland in company with Mr. Bartlett of the Zoological Gardens, London.

Of that visit an interesting account is given in an article afterwards published in *Notes and Jottings from Animal Life*. At some little distance from the house above named, says Mr. Buckland, "there is a lonely pine-wood. Through part of this wood runs a natural stream. In the centre of the wood a stone wall has been built in such a manner as to keep the beavers perfectly quiet and undisturbed.

"As far as could be ascertained by the curator of the beavery there were twelve beavers. There were certainly one or more young ones in the big house which these most intelligent animals had erected. These when born are about as large as rats; and from their size and other observations the curator thinks that beavers have two litters of cubs in the year.

"On entering the inclosure one might easily imagine that a gang of regular woodcutters had been

at work felling the trees all around them. Woodcutters had indeed been at work very busily, but they were not biped labouring men working with sharp axes, but fur-clad quadrupeds, armed by nature with exceedingly sharp powerful teeth.

"The original stream, which flows gently down a slight incline, is now divided into one larger and two smaller ponds by means of dams or weirs,

which the beavers have built directly across the run of the water.

"It is difficult, if not impossible, to see these wonderful dam-makers at work, as they generally, I hear, are out at night and are very shy beasts. From the structure they have made it is evident that they work with a design, I may even say with a definite plan. The trees have been cut down in such a manner that they shall fall in the position in which the beaver thinks they would be of the greatest service to the general structure, generally right across the stream. The cunning fellows seem to have



Fig. 208.—The Common Dormouse (*Muscardinus avellanarius*). p. 149.

found out that the lowest dam across the river would receive the greatest pressure of water upon it. This dam, therefore, is made by far the strongest. They seem to have packed, repaired, and continually attended to the tender places which the stream might make in their engineering work.

"A fact still more curious—the custodian of the beavers pointed out to us a portion of the work where the dam was strutted up and supported by the branches of trees extending from the bed of the stream below to the sides of the dam—forming, in fact, as good supports to the general structure as any engineer could have devised. . . .

"Mr. Bartlett and I closely examined the markings of the beavers' chisel-like teeth on the trees which they had cut down. These trees were oak, larch, pine, birch, and willow. The young ones, judging from the markings of their teeth, are not such good workmen as their parents, and one would

almost imagine that it was necessary for them to go through some sort of education in cutting down trees. It is very interesting to observe how the beaver goes to work to cut down a tree. Attacking one side he cuts, by means of his sharp chisel, a regular notch in the tree. One side of this notch is flat like a saw cut; the other side is brought down to the saw cut by an angle; in fact, he cuts down the trees by the same sort of incision as we ourselves employ to cut a stick out of the hedge. Mr. Bartlett informs me that he has seen the beaver put his head so far into the notch that he was afraid the weight of the tree from above would crush down upon him and smash his head; but Mr. Beaver is a better carpenter than this. Mr. Bartlett has seen him at this stage of the proceedings come out and go to a little distance, sit on his hind-legs, and inspect the tree with the air of an engineer looking at a scaffold in process of construction. When the beaver has gnawed his notch as deep as he dare into the tree, the cunning fellow will test its stability by standing on his hind-legs and pushing the tree to see the degree of firmness of the portion which holds the two pieces of wood together; but how is he to separate the bit which unites the wood? He simply leaves off gnawing the big notch he has made. He then goes to the other side, where the bark and wood have not been touched at all, and gnaws away until down comes the tree.

"These beavers are most industrious little animals. These water-carpenters have converted the place into a regular subterranean city, for they have burrowed out the earth in such a manner as to form streets, galleries, highways, and by-ways. These runs, I imagine, are made primarily for the purpose of safety, and secondly that the houses or dams may be connected together, so that the families living in the different huts may be able at will to visit their friends."

Of the beaver family to which the preceding paragraphs relate, there survived in the spring of 1887, as the owner of the family was kind enough to inform the translator of the present work, only two individuals. These, however, were apparently healthy, having raised a new dome-shaped house and done a great deal of work in damming, &c.]

Many writers have uttered sentimental complaints regarding the extirpation of the beaver, but it cannot be denied that this is one of the most destructive of animals. We

have more need of timber than of its fur and castoreum. It feeds chiefly on roots and the bark and young wood of trees in which the sap is flowing, and it builds dams and habitations in the water out of stems and branches, sometimes measuring 2 feet in diameter. It thus causes considerable devastation in forests, especially among willows and poplars. The beaver is consequently an animal that is bound to disappear before the advance of cultivation, and which neither complaints nor pious wishes will be of any avail to preserve.

The beaver is one of the largest of rodents. It attains a length of more than 3 feet, and its flat scaly tail measures about 12 inches. Its weight may amount to 66 pounds. The body is short and thickset, the back arched. The head is thick and blunt in front. The legs are short and thick, and have five toes with small nails. The hind-toes are connected by a web. The small eyes have a large nictitating membrane, the nostrils are capable of being closed, and the short round ears may be laid over the external ear-passage (auditory meatus) in such a manner as to close it in diving. With respect to the structure of the sexual organs of the female the beaver has a remarkable resemblance to the marsupials, or even to the monotremes. The fur consists of a fine soft down interspersed with long bristly hairs; it is of a fine chestnut-brown colour, darker on the back than on the under parts. The four cheek-teeth in each half of the jaw present to view extremely complicated folds on the grinding surface; the thick and broad incisors are covered with a dark-brown layer of enamel. The castoreum is secreted in two pouches in the neighbourhood of the anus.

The American beaver (Pl. XXXVI.), which many naturalists take to be a distinct species, is beyond doubt only a geographical variety. It is rather darker than the European, and has a narrower head and a curved profile.

Beavers live in holes, which are dug out on the banks of rivers, and have their entrance under the water like those of otters. From the entrance a tunnel leads obliquely upwards to a chamber which lies above the level of high water and to which air is admitted by a narrow opening. In retired places they build dams across the streams out of the trunks of trees, which are driven into the ground and have their branches consolidated by earth. In this manner they convert streams into a series of pools with a constant level. In front of these dams they construct out of clay regular fortresses with arched roofs, which have the entrances under the water, and in addition to the warmly lined dwelling-chambers contain also provision rooms. The beavers are extraordinarily expert in the use of their fore-feet and teeth in the working up of the various materials which they carry or drag to the desired place, waddling on erect on their hind-feet as they do so. In the construction of these dams and dwellings the beaver undoubtedly reveals a decided mental superiority to other rodents. Its flesh, which was regarded as one of the meats that might be used during fasts, is very palatable, and the tail is considered a delicacy.

The beaver is generally caught in traps. America yields about 100,000 skins yearly. The castoreum is in high esteem; it is almost ten times as valuable as the fur. There are some Indian tribes which live almost exclusively by catching the beaver.

[The following extracts, besides furnishing some further details of interest regarding the habits of the beaver and its trapping in older days, show at least that some of the generally received accounts of this animal do not apply to its behaviour in all parts of the region inhabited by it even in North America:—

“In regard to the beavers' houses, I am forced to come to the conclusion, either that travellers who have written regarding the beaver in the country east of the Rocky Mountains, have woefully taken advantage of a traveller's license, have

listened to mere hearsay wonders without seeing for themselves, or that the habits of the beaver differ much in different parts of the country.

“It is only after they have been pointed out to you that the ‘houses’ can be recognized, as they seem like loose bundles of sticks lying on the water. In a recent account of the beaver in the British provinces in North America by an anonymous writer, the houses are described as being exactly the same as I have seen them in the West, and not plastered domes. The vigilance of the little builders is so great that it is rarely, unless closely watched for a long time, that they can be seen. A passing traveller rarely surprises them at work. . . . The only approach to plastering their houses which I have observed is its giving a self-satisfied ‘clap’ of the tail on laying down its load. . . .

“In winter *they have a store of food secured at some convenient distance from their abodes.*¹ When they require any they start off to get it. They do not eat there, but bring it to their house, and there make their meal. Of the almost human intelligence of the ‘thinking beaver’ the stories are innumerable; but many of them are much exaggerated, or even fabulous (such as Buffon's account). The following is tolerably well authenticated, my informants vouching for the accuracy of it. In a creek about four miles above the mouth of Quesnelle River, in British Columbia, some miners broke down a dam in the course of the operation for making a ditch, at the same time erecting a wheel to force up the water. Beavers abounded on this stream, and found themselves much inconvenienced by these proceedings. Accordingly, it is said that, in order to stop the wheel, the beavers placed a stick between the flappers in such a way as to stop the revolutions of the wheel. This was so continually repeated night after night, and was so artfully performed, as to preclude the possibility of its being accidental. . . .

“When beaver was 30s. per lb. Rocky Mountain beavers were piled up on each side of a trade-gun until they were on a level with the muzzle, and this was the price! The muskets cost in England some 15s. These were the days of the free trapper—joyous, brave, generous, and reckless—the hero of romance, round whom many a tale of daring circles, the love of the Indian damsel, the beau ideal of a man in the eyes of the half-breed, whose

¹ Mr. Green, the writer of the communication from the notes to which these extracts are taken, states that one day's supply of sticks for a single beaver would fill a house.



To face page 152.

PLATE XXXVI. — THE BEAVER (*Castor fiber*).



ambition never rose higher than a *coureur des bois*—a class of men who, with all their failings, we cannot but be sorry to see disappearing from the fur-countries. The fall of beavers' peltry rang their death-knell; and, as a separate profession, trapping is almost extinct, being nearly altogether followed, at uncertain spells, by the Indians and the lower class of half-breeds. The world is fast filling in; the emigrant, with his bullock-team and his plough, is fast destroying all the romance of the far West—fast filling up with the stern prose of the plough and the reaping-machine and the whistle of steam what was once only claimed by the pleasant poetry of the songs of the *voyageur*, the *coureur des bois*—the hunters and trappers of the great fur companies! But perhaps it is better after all!"—Notes by Mr. R. Brown to a communication

by Mr. A. H. Green "On the Natural History and Hunting of the Beaver on the Pacific Slope of the Rocky Mountains," read before the Linnean Society; *Linnean Society's Journal*, vol. x.]

THE MOUSE FAMILY

(MURIDA).

The large family of the rats and mice and their kindred is so numerous and varied that many naturalists have erected it into a sub-order, which, however, has no well-marked distinctive characters. One might almost say that in this family have been included all those forms which are connected together by almost imperceptible links of transition, and which could not well be referred to any other family. In this respect this family plays pretty much the same rôle as that of the antelopes among the ruminants. In general

VOL. 11.

the members of this family have only three cheek-teeth in each half of each jaw, and these teeth exhibit in most cases transversely-placed tubercles, whereby an approach to the zygodont structure is brought about. When worn away by use these tubercles often appear as more or less complicated folds, and then the cheek-teeth have distinct roots. In other cases, however, there are cheek-teeth with lamellæ and without roots; there are also cases in which only two cheek-teeth are

present; and lastly, those in which the upper jaw alone possesses four teeth of this kind. The mice always have well-developed collar-bones. Usually there are on the fore-feet four



Fig. 209.—The Common European Mole-rat (*Spalax typhlus*).

toes and a rudimentary first digit; the hind-feet have five toes. The tibia and fibula are fused together in their lower parts. On the whole no general characters can be given. From among the numerous groups we have selected only a few characteristic representatives.

The Mole-rats.

The Common European Mole-rat (*Spalax typhlus*), fig. 209, may be taken as the representative of this family, the Spalacida, a group consisting of a large number of animals resembling the moles in their habit, their behaviour, and their underground mode of life. Their head, however, presents some differences. It is short, broad, almost as round as a ball, and shows in front, instead of the rather long snout of the moles, the large incisors not covered by the lips. The

eyes are very small, often quite hidden under the skin; the external ears are altogether wanting; the tail is rudimentary or quite absent. The form of the body resembles that of the moles. The stout fore-feet are furnished with four toes with powerful burrowing claws and a rudimentary first digit covered with a smooth nail. These animals

live in underground galleries, in the course of which they throw up little mounds of earth like mole-hills. In plantations they cause considerable damage by gnawing away the roots even of large trees. The species represented in fig. 209 is a native of the east of Europe, very abundant in Ukraine and Moldavia, not rare in Hungary, and met with



Fig. 210.—The Hamster (*Cricetus frumentarius*).

as far as the Caucasus and the Urals. The minute eyes are completely covered with skin. The fur is silky, soft, thick, and of a dark yellowish-gray colour. The three cheek-teeth have two enamel folds running into them, and small spots of enamel in the centre.

The Hamsters.

This group (*Cricetus*) forms the transition to the field-mice and the rats, but is distinguished by the presence of enormous cheek-pouches opening into the mouth, covered with a sinewy membrane, and sometimes extending immediately beneath the skin far back, even behind the shoulders. The first cheek-teeth have six tubercles arranged in three transverse lines, the others only four.

The typical species, the **Hamster Proper**

(*Cricetus frumentarius*), fig. 210, is met with in corn-fields in the temperate parts of Europe, from the Vosges on the one side to the Urals on the other. Formerly it was much more widely distributed, but it has never passed beyond the Vosges within historical times, although in certain years it is tolerably abundant in Alsace and the Palatinate of the Rhine. It is a plump, compact animal with short legs, and measures about 12 inches in length. The head resembles that of a cat, with short broad rounded ears and brilliant moderately large eyes. The tail is very short; the toes, notwithstanding the burrowing habits, have only short claws. The thick fur is brownish on the back, black underneath, and bright yellow on the feet and the rest of the body. Light-yellow patches separate the

two leading tints on the sides of the head, the breast, and the flanks. As regards the distribution of the colours, however, there are numerous varieties.

The hamster is a remarkably destructive animal, which in many years multiplies with almost incredible rapidity. It confines itself to cultivated fields, where it digs tunnels in all directions, and forms its nest and provision

cellars. These it fills chiefly with grain, which it carries home in its enormous cheek-pouches. It is a real pest in Saxony and Thuringia, where hamster years are recorded as cockchafer years are elsewhere. In a single year a hamster can store up as much as a hundredweight of grain. All methods are resorted to for its destruction, and its provision stores when found are used like



Fig. 211.—A Brown Rat (*Mus decumanus*) attacking a Black Rat (*Mus rattus*).

grain kept in a granary. The hamster is at once an ill-tempered and courageous animal, which, small as it is, will spring at the throat of dogs, bite men on the legs, and seek to destroy every animal it meets with in order to devour it. It is very fond of eggs and birds.

Rats and Mice.

This remarkably numerous group (Murina) has the same sort of dentition as the hamsters, cheek-teeth with tubercles and true roots, but the cheek-pouches are absent, and the tail, which is longer, is ringed, scaly, and sparsely covered with hair, the hair being arranged in accordance with the rings. The typical genus may be divided into two groups: the larger members forming the Rats, in which the grooves of the palate run from the teeth

on one side of the mouth to those on the other side, and the smaller members forming the Mice, in which these folds are separated in the middle. In this genus are found, along with the field-mice, the most disagreeable pests of human dwellings.

The Black Rat (*Mus rattus*), fig. 211, attains a length of 6 inches, while the tail measures $7\frac{1}{2}$ inches, and is furnished with at least 260 rings. On the back this rat is of a dark-brown colour, underneath rather lighter. Till the beginning of last century it was the master on European soil, and only occasionally had to fight against another rat with white belly, which was more common in the south and in Egypt (*Mus tectorum* s. *leucogaster*). It accompanied man wherever he went, travelled round the whole earth on

ships, and settled everywhere—in the Tropics as in the Frigid Zone, in America as in Australia. But this almost universal dominion has been greatly encroached on by the immigration of another rat, more powerful and more ferocious, from Asia into Europe, and in the latter continent the **Brown Rat**, as it is called (*Mus decumanus*), fig. 211, has everywhere displaced the black rat. In the year 1727 prodigious swarms of the brown rat swam across the Volga in the neighbourhood of Astrakhan, and since then this species has multiplied with great rapidity, extinguished the black rat, peopled Europe, and has also reached transoceanic countries on ships. At the present day the brown rat has already advanced beyond the Mississippi, and soon it will have overrun the whole territory of the United States as it has already done

the whole area of Europe. It lives in the sewers of towns, in houses, barns, and stables, and may become a real plague, and above all on ships. The brown rat attains a length of 8 inches; the tail has only about 220 rings. The hair is coarse, and of a grayish-brown colour on the back, lighter underneath. It eats anything, destroys everything, burrows everywhere, is courageous and fierce, and, like all members of the group, extraordinarily prolific. An albino variety with white hair and red eyes is pretty common.

The **Mice** are not such mischievous destroyers, but nevertheless are far from agreeable companions. In fig. 212 is represented

the **Common Domestic Mouse** (*Mus musculus*), which attains a length of 4 inches at the most. Its tail, with about 180 rings, is just about as long as the body. The colour is a well-known gray, a little darker on the back than on the under parts. The houses, cellars, and barns which it inhabits it is very unwilling to quit, and it hardly ever ventures beyond the gardens into the fields, where it is replaced by the **Field-mouse** (*Mus agrarius*); in the woods the **Long-tailed Field-mouse** takes its place (*Mus sylvaticus*); and in many corn-fields and reedy marshes there is a smaller species, the **Harvest-mouse** (*Mus (Micromys) minutus*), which builds for itself a round nest hanging to the stalks of the corn or reeds. In Algeria and the steppes of the interior of Africa occurs one of the prettiest members of this genus, the



Fig. 212.—The Common Domestic Mouse (*Mus musculus*).

Striped or Barbary Mouse (*Mus striatus (barbarus)*), fig. 213. Its fawn-coloured fur is marked with ten dark-brown longitudinal stripes; the belly is white. It attains a length of very nearly 5 inches.

All these mice lead much the same kind of life, residing in holes, where they make nests for their frequent litters of young. From eight to ten young ones are always born at a birth. The period of gestation is never more than four weeks, and at the age of four months the young animals are already capable of reproduction. A new period of gestation begins almost immediately after the birth of a litter. If one will only take the

trouble to reckon up the number of generations | joke. They next went forward with as much possible during the summer months, from April to October, one will get some idea of the almost fabulous rate of multiplication of these little creatures.

[In South Africa Livingston met with a species of "rats, or rather large mice, closely resembling *Mus pumilio* (Smith)," which he says are "quite facetious, and, having a great deal of fun in them, often laugh heartily. Again and again they woke us up by scampering over our faces, and then bursting into a loud laugh of He! he! he! at having performed the feat. Their sense of the ludicrous appears to be exquisite; they screamed with laughter at the attempts which disturbed and angry human nature made in the dark to bring their ill-timed merriment to a close. Unlike their prudent European cousins, which are said to leave a sinking ship, a part of these took up their quarters in our leaky and sinking vessel. Quiet and invisible by day, they emerged at night, and cut their funny pranks. No sooner were we all asleep, than they made a sudden dash over the lockers and across our faces for the cabin-door, where all broke out into a loud He! he! he! he! he! he! showing how keenly they enjoyed the

forward with as much delight and scampered over the men. Every night they went fore and aft, rousing with impartial feet every sleeper, and laughing to scorn the aimless blows, growls, and deadly rushes of outraged humanity."—*Expedition to the Zambesi*, chap. vi.]

The Voles.

This group (*Arvicolina*) consists of rodents very similar to the rats and mice, but distinguished from them by their thicker head with broad blunt muzzle, their thickset body, the structure of their cheek-teeth. These have such a large number of enamel folds crossing one another at acute angles, that the grinding surface of the three very close-set teeth of this kind forms a long zigzag line. The field-voles live like the true field-mice, do no little damage in plantations and forests, but never enter houses. They flee as much as possible from the presence of man.

Of the numerous native members of this

group we mention first of all the Common Field-vole, Campagnol, or Short-tailed Field-



Fig. 213.—The Striped or Barbary Mouse (*Mus striatus*).



Fig. 214.—The Common Field-vole (*Arvicola arvalis*).

mouse (*Arvicola arvalis (agrestis)*), fig. 214. | considerably shorter tail. This rat digs tunnels in the neighbourhood of water, and lays waste plantations, though at the same time it is very fond of a flesh diet. It is a capital swimmer and diver. It is still a matter of doubt whether the *scherrmaus* of the Germans, which does not frequent the water, is the same species or only a variety.

It is of about the size of an ordinary mouse, but its tail measures little more than an inch out of a total length of $5\frac{1}{2}$ inches. The colour is a yellowish-gray, somewhat darker on the back than underneath; on the belly it is a dirty white inclining to red. It is this field-vole in particular which devastates our fields: sometimes it multiplies to such an extent that the harvest is totally destroyed. In the circle of Zabern (Saverne) in Alsace, in the mouse year, 1822, a million and a half | tened head, and with ears hidden in the fur.



Fig. 215.—The Water-rat or Water-vole (*Arvicola amphibius*).

of these destroyers were killed. Foxes, polecats, weasels, owls, mouse-buzzards, and other beasts of prey are of all the less avail in checking its devastations, since these animals are themselves relentlessly destroyed in the most senseless manner.

The Water-rat or Water-vole (*Arvicola amphibius*), fig. 215, likewise belongs to this genus. It is of the same colour as the black rat, and attains about the same size,



Fig. 216.—The Lemming (*Myodes lemmus*).

but is distinguished from it by its thick blunt | and the Alps. Species allied to it are found head, its short broad rounded ears, and its | in Siberia and Canada. On the high plateaux

The lemming attains the size of a moderate-sized rat, but has a tail only about an inch in length. On the fore-feet the first digit is completely developed. The coat resembles that of the hamster, and is in general of a yellow colour with brown spots and white stripes. The under parts are likewise rather whitish.

The lemming inhabits the northern parts of Europe. During the Ice Age its domain extended as far as the Pyrenees

of the Scandinavian Alps, in Lapland and Finland, it is met with everywhere. It lives like the hamster, and like this kinsman, too, is courageous and vicious notwithstanding its small size. In favourable years it multiplies to such an extent that enormous swarms are compelled to emigrate in order to seek their food elsewhere. In spite of the fact that their habitual mode of life is a nocturnal one, they

then move on in a close phalanx in the full light of day, swim across brooks and even rivers, and are not deterred by the fact of their being pursued by eagles, falcons, and small carnivores. The carcasses of those which die on the way pollute the air all round. Similar migrations of the brown rat, voles, and other rodents have been observed.

The Musk-rat, the Musquash of Canada,



Fig. 217. —The Musk-rat or Musquash (*Fiber zibethicus*).

the *Ondatra* of the Indians (*Fiber zibethicus*), fig. 217, is a species living entirely in the water. This is a pretty large rat, whose compressed and flattened tail, sparsely covered with stiff bristles, is of about the same length as the body. In the neighbourhood of the anus there is a gland of the size of a nut, which secretes an oily substance with a strong smell of musk. The five toes of the hind-feet as well as the four toes of the fore-feet are connected by a web set with stiff intercrossing bristles, which are of service in swimming. The coat consists of very fine thick soft woolly hair, beyond which projects a number of long glossy bristles. On the back the colour is brown, on the belly reddish-gray. In Canada it is eagerly hunted for the sake of its very valuable fur. About three millions of skins are obtained every year. The mode

of life of the musk-rat is similar to that of the beaver. According to circumstances it either excavates tunnels on the steep banks of rivers or constructs regular fortresses with domed roofs rising above the surface of the water; but such fortresses are of course distinguished from those of beavers by their much smaller size.

We now mention a few mice of which no illustrations are given, but which yet deserve some attention.

First there is the Australian genus *Hydromys*, which is distinguished from all other rodents by the remarkably small number of its cheek-teeth. In each jaw there are, in fact, only two such teeth; these have oval enamel folds. This genus lives in the water like the musk-rats. The fore-feet are adapted for burrowing, the hind ones for swimming.

This animal is one of the few placental mammals of Australia.

Secondly, we mention, by way of transition to the next family, mice with elongated hind-legs. Some of these (*Meriones*) have almost the habit of hares. They dwell in the steppes round the Caspian Sea. Others (*Gerbillus*) have a greater resemblance to the jumping-

the collar-bone is present, and there are almost always five toes armed with sharp claws. A single American genus (*Jaculus*), which is found in the Arctic Regions round Hudson's Bay, has only four toes and a rudimentary first digit with a flat nail. These fore-feet are used in walking only while the animal is feeding; as a rule the jerboa goes



Fig. 218.—The Egyptian Jerboa (*Dipus mauritanicus*).

hares, and occur in Africa. They have a long tail without any terminal tuft.

THE JERBOA FAMILY

(DIPODIDA).

This family is so sharply distinguished from all other rodents by the structure of their hind-legs that some naturalists have constituted them a sub-order. Their whole structure is adapted for jumping, and we find resemblances in this structure on the one hand to the kangaroos, and on the other hand to the jumping-shrews among the Insectivora. The fore-feet, although very much reduced in size, are yet perfectly well formed;



Fig. 219.—The Jumping-rabbit of Siberia (*Alactaga jaculus*). p. 162.

only on two feet, and the fore-feet are commonly used only for conveying food to the mouth or for burrowing. The hind-leg, which when extended to its full length is longer than the body, has a long and thick shin-bone (tibia), while the fibula is rudimentary or rather degraded. The ankle is greatly reduced with the exception of the heel-bone (calcaneum), on which is a long projecting process serving as a lever for the attachment of the tendons of the muscles used in jumping. The metatarsus is almost as long as the tibia, and shows the greatest variety of structure. In *Jaculus* and the jumping-hares, which have five or four toes on the hind-feet, there is the same number

of metatarsal bones; in the *Alactagas* there are three distinct metatarsal bones for each of the three perfect toes, while the two rudimentary toes have none; in the jerboas proper, finally, which have only three toes, the metatarsal bones are fused together into one, which shows at its lower end three rounded pulley-like surfaces for the three

toes, and thus exactly resembles that of birds. There is, accordingly, a marked tendency to this fusion. The hind-toes are always long and armed with erect claws. The jerboas run like long-legged birds, make enormous leaps, and in doing so draw their fore-feet towards their breast or lay them on their cheeks. The tail, usually of considerable



Fig. 220.—The Cape Jumping-hare (*Pedetes caffer*). page 162.

length, serves as a rudder in leaping; except in the jumping-hares (*Pedetes*) it has only a terminal tuft; in the forms mentioned it is completely covered with hair. The jerboas live in steppes and deserts and are nocturnal in their habits. By day they hide in their holes, which they hollow out with remarkable rapidity. Their food consists of seeds, insects, and the eggs of small birds. The northern species have a deep winter sleep, and with a view to this build a warm nest.

The Egyptian Jerboa or Common Jerboa of Northern Africa (*Dipus mauritanicus (aegyptius)*), fig. 218, is the best-known species. It can be abundantly procured in Algeria and Egypt, where it is wide-spread in the desert

tracts. Besides the characters above mentioned this genus has three cheek-teeth with tubercles and folds of enamel. The head of our species is round and arched, the ears are pretty large, and the whiskers of considerable length; the three toes of the hind-feet are protected against the heat of the sand by small bunches of hair. The fine thick coat of hair has the colour of the sand of the desert. The animal is especially fond of the alfa-covered steppes, lives socially, and digs holes of no great depth, which communicate with one another. In captivity the jerboa is a charming creature, of gentle disposition and very cleanly habits, by no means timid; but it is advisable to keep it in metal cages.

The *Alactagas* (*Alactaga* or *Scirtetes*) of Africa, and its mode of life resembles that of the members of allied genera. It also lives in holes in the ground. Its flesh is as highly esteemed as that of our own hare.

The **Cape Jumping-hare** (*Pedetes caffer*), fig. 220, resembles an ordinary hare in the shape of its ears and the colour of its fur, and is of about the same size; but its fore-legs are stronger and the hind-legs shorter than in the allied jumpers. The feet are completely covered with hair and have five free toes furnished with hoof-like nails. The long tail is likewise completely covered with hair. The four cheek-teeth have only a single enamel fold, which in the lower jaw runs in from the interior and in the upper from the exterior. The jump-

ing-hare is a native of the steppes of Southern | group the **Gopher** (*Geomys bursaria*), fig. 222,



Fig. 221.—Phillips's Pocket-mouse (*Dipodomys Phillipsii*).



Fig. 222.—The Gopher (*Geomys bursaria*).

the members of allied genera. It also lives in holes in the ground. Its flesh is as highly esteemed as that of our own hare.

A rather aberrant genus is that of the "Pocket-mice" of the Americans (*Dipodomys*), which are natives of California and Mexico, and in which the possession of cheek-pouches opening externally by lateral slits is added to the general habit of jerboas. The pouches are situated on both sides of the

Phillips's Pocket-mouse (*D. Phillipsii*), fig. 221, lives in general like the jerboas. Its domain extends even to Texas. It is scarcely larger than a mouse.

A series of American genera in which the difference in size between the fore and hind legs tends more and more to disappear, leads up to the clumsy thickset forms resembling the moles in form, and possessing three simple cheek-teeth without roots. We select as representative of this

which attains the size of an ordinary rabbit, and lives like moles in Canada and the Rocky Mountain region. It digs out tunnels, builds complicated nests, and throws up mounds of earth. Notwithstanding its underground life its eyes are well developed; the external ears, on the other hand, are altogether wanting; the tail is thin and short. The strong claws on the five toes attain a considerable length, especially on the fore-feet. The cheek-pouches opening externally on the sides of the mouth are very large and reach back to

the shoulders. The fur is soft and velvety like that of a mole; it is of a dark-gray colour, reddish on the back, lighter underneath.

THE PORCUPINE FAMILY

(HYSTRICIDA).

This family comprises mostly clumsy thick-set forms, which have a defensive armour consisting of spines on the back. In each half of each jaw they have four cheek-teeth with or without roots, but always provided



Fig. 223.—The African Brush-tailed Porcupine (*Atherura africana*). page 164.

with enamel folds. The collar-bones are not fully developed; in most cases only the middle portion is ossified, while the two ends are still cartilaginous or tendinous. The porcupines may be divided into two groups: those of the Old World are animals that live on the ground; those of the New World, on the contrary, are arboreal in their habits, and often even have a tail capable of being rolled up.

The **Common European Porcupine** (*Hystrix cristata*), Pl. XXXVII., inhabits the countries on the Mediterranean, but is especially abundant in Algeria and Asia Minor, while in Italy, Sicily, and Spain it has become rather rare. On account of its plump thickset body it has been compared to the pig. It attains

a length of rather more than 2 feet, but the short thick tail measures only about 4 inches. The head is blunt in front and has an arched brow. The upper lip is cloven, and this cleft communicates with a transverse groove into which the nostrils open. The first digit is rudimentary, especially on the fore-feet, but the other toes, four in number, are all provided with strong sharp claws. The front part of the body is covered with short strong bristles. The bristly defensive armour begins on the brow. The hairs, which are at first flexible, become stiffer and stiffer till they at last acquire the form of strong spines marked with alternate stripes, such as we are all familiar with as used for pen-holders, brush-holders, and the like. These spines, which

cover the whole of the hinder part of the body, can be erected or depressed at pleasure by means of a strong superficial muscle. The noise occasioned thereby resembles the crackling of withered branches. The animal places itself in an attitude of defence by rolling itself up in the form of a ball, concealing its head under its body, and presenting the points of its spines all round. The spines easily come off, and when they do so they show the strong bristly hairs with which they are intermingled. The tail also is set with spines. This armour is not in general so dangerous as it appears. If we press down the spines with a stick it is easy to seize the animal by the nape of the neck, and porcupines inspire the carnivorous animals with no dread.

The porcupine lives a solitary life in holes which it digs in the ground, and which it quits only at night. It is easily tamed, but it exhibits extremely little intelligence. Its scent is keen.

The **Brush-tailed Porcupines** (*Atherura*) are distinguished by their rather long body resting on short legs. The tail is as long as the body, and ends in a bunch of flattened horny strips which are curiously twisted and cut. Were it not for this singular appendage

of the tail and the very sharp-pointed smooth spines, which have a deep longitudinal groove, these animals, with their short legs, round head, and rounded ears, would resemble an ichneumon rather than a porcupine. The species shown in fig. 223, the **African Brush-**

tailed Porcupine (*Atherura africana*), is a native of Fernando Po; the other species live in tropical Africa, in the East Indies, and on the Sunda Islands. Their mode of life is nocturnal. The spines of all these species are much more formidable than those of the porcupine. They end in a recurved hook, and since they come out very readily, they remain sticking in the wound which they make.

The porcupines of the New World are all



Fig. 224.—The Tri-coloured Tree-porcupine or Cuy (*Cercolabes villosus*).

climbers, and the South American species have a tail capable of being rolled up like that of a howling-monkey. As representative of this group we have selected the **Tri-coloured Tree-porcupine**, the Cuy of the natives (*Cercolabes villosus*), fig. 224. The length of its body is about 2 feet; the pointed tail is naked on the back and measures about 14 inches. The various species of *Cercolabes* are distinguished almost solely by their colour and the relations of the spines and bristles on their back. Their behaviour is like that of sloths; in all their movements they are ter-



To face page 164.

PLATE XXXVII. — THE PORCUPINE (*Hystrix cristata*).

ribly slow. By day they remain cowering on the branch of a tree to which they attach themselves by means of their tail, and they go out in search of their food only at night. They feed on the leaves of trees. The spines have only a very thin root, but they are somewhat thicker in the middle, and at the end they are as sharp as a needle, and are provided with a barb, which easily breaks off. These tree-porcupines are more detested

by hunters than any other animals; they are, perhaps, even more dreaded than the rattlesnake. A dog which attacks a cuy at once gets its mouth full of spines, which break off when one attempts to pull them out, and in consequence of their barbs penetrate more and more deeply into the flesh. The tail of the allied North American genus of the *Ursons* (*Erethizon dorsatum*) does not serve for grasping, but the animal is large and



Fig. 225.—The Coypu (*Myopotamus coypu*).

thickly covered with those dangerous spines. In defending itself against attack the animal deals vigorous blows with its broad tail.

THE SPINY RAT FAMILY

(ECHIMYIDA).

Beside the porcupines we place the spiny rats, which are chiefly met with in South America, but have a few representatives also in tropical Africa. They have four cheek-teeth, which are sometimes simple, sometimes composed of a series of enamel folds like those of the beaver, and mostly have roots. The collar-bones are complete, and the feet usually have five toes. The hair is mostly coarse, interspersed with glossy bristles, and

often also with a few real spines, which are sharp but short. Some of these animals are climbers—for example, the capromys of the Antilles—but the majority of them are terrestrial animals living like the rats and mice. The type selected by us is an inhabitant of the water.

The **Coypu** of the Indians (*Myopotamus coypu*), fig. 225, is a native of South America, and inhabits more particularly the marshes bordering on the Rio de la Plata and its tributaries. Its fine fur consists of soft woolly hair and glossy bristles, is of a beautiful brown colour, and is known to the fur-dealers by the name of the "Plate beaver." The animal exceeds 3 feet in length including the tail, which is about equal in length to the

body. The tail is round, thin, ringed, and covered with inconspicuous scales. The thick flat head is blunt in front, and carries small ears; the short sturdy legs have five toes

seldom on trees, and when attacked dart courageously in large numbers on their assailants. Allied genera (*Ctenomys*) advance as far south as the desert tracts of Tierra del



Fig. 226.—The Degu (*Octodon Cummingii*).



Fig. 227.—The Larger Chinchilla (*Eriomys chinchilla*).

connected by webs. The coypus live in pairs in holes on the edge of the water; they are excellent swimmers, but dive badly and seldom; they seek their food by day.

THE DEGU FAMILY

(OCTODONTIDA).

This family owes its scientific name¹ to the fact that the enamel folds of its four cheek-teeth form on the grinding surface a figure of 8. The feet have for the most part five toes, and the collar-bone is always fully developed. The typical species, the Degu of the Chileans (*Octodon Cummingii*), fig. 226, has the size, habit, and colour of a rat, and is very abundant in Chile, where it does a great deal of damage in cultivated fields and gardens. These rats dig holes and galleries, clamber about in hedges and shrubberies, but

¹ From Gr. *oktō*, eight, and *odous*, *odontos*, a tooth.

Fuego, and climb to the higher parts of the Cordilleras.

THE CHINCHILLA FAMILY

(CHINCHILLIDA).

South America, which is so rich in rodents generally, possesses another family of importance for us, that of the Chinchillida. The distinguishing character of this family is formed by the four rootless cheek-teeth, which consist of two or at the most three bands of enamel placed obliquely and connected together in such a manner that each tooth appears to be composed of two oval halves. The collar-bones are complete; the fine soft fur is almost woolly.

The Chinchillas Proper (*Eriomys* or Chinchilla) occupy the first place in this family. They lead a similar life to our marmots, and are natives of the higher rocky and treeless

parts of the Cordilleras of Peru, Chile, and Bolivia, where they are much hunted on account of their extraordinarily fine and soft fur, which has a pretty silvery look and is of a pearl-gray colour. Illustrations are given of the two species to which the name Chinchilla is specially applied, and which are celebrated under that name on account of their extremely valuable fur. The first of these (*Eriomys chinchilla* (*Chinchilla brevicaudata*)), fig. 227, is of about the size of a squirrel, but has a much more thickset body. It is distributed over Peru and Bolivia. |



Fig. 228.—The Smaller Chinchilla (*Eriomys laniger*).

The other (*Eriomys laniger* (*Chinchilla lanigera*)), fig. 228, is the smaller species, and occurs chiefly in Chile. In both species the head is round, and the ears are large, the whisker-hairs long and thick. The fore-feet have five pretty long divergent toes, the hind ones four toes with short claws. The genus is likewise characterized by having the cheek-teeth composed of three narrow plates of enamel, and their tail completely covered with hair, as well as by their naked ankle (tarsus).

The chinchillas are

agile animals, which run and climb well.



Fig. 229.—Cuvier's Lagidium (*Lagidium Cuvieri*). page 168.

They are fond of stony districts, and live | They resemble marmots in their general socially in holes dug out by themselves. | mode of life. In confinement they are ex-

tremely graceful, gentle, good-humoured, and cleanly, yet they may become rather troublesome from their curiosity and their disposition to gnaw everything that comes in their way. Their flesh resembles that of the wild rabbit.

The members of the genus *Lagidium* (or *Lagotis*) inhabit the same regions as the chinchillas, and resemble these latter in the

structure of their teeth, but are distinguished by having longer legs, a less delicate fur, much longer ears, and a long tail, which is haired only on the upper surface. The general appearance of these animals is something like that of a long-tailed hare. They run and jump like hares, and excavate burrows like rabbits, to which they are about equal in



Fig. 230.—The Vizcacha (*Lagostomus trichodactylus*).

size. They are hunted solely for the sake of their savoury flesh. An illustration is furnished of the species which is so abundant in the higher parts of Peru (*Lagidium* (*Lagotis*) *Cuvieri*), fig. 229.

The Vizcacha (*Lagostomus trichodactylus*), fig. 230, is the only species of this family that descends to the lowlands. It literally renders the Pampas of the Argentine Confederation and Patagonia unsafe by the enormous burrows which it makes. These burrows are in communication with one another, and are occupied by families which sometimes number as many as fifty individuals. By day the vizcachas rest, but at night they move out in dense crowds. On account of the danger caused by their burrows to horses,

which frequently stumble in them and get overthrown, the vizcachas are thoroughly detested and relentlessly destroyed at every opportunity. Whenever possible their burrows are placed under water; the vizcachas themselves are pursued by dogs, against which, however, they defend themselves bravely. The vizcachas are distinguished from the members of allied genera by their thicker head and more thickset body, by their long stiff whiskers, their dentition, and their rather short but very hairy tail; moreover, the fore-feet are four-toed, the hind ones only three-toed. The first three cheek-teeth have two quite separate oval rings of enamel, the last has three of these. The body attains a length of about twenty inches. The colour is

a dark gray on the back, but the belly is white, and there is a white stripe across the nose and cheeks.

THE AGOUTI FAMILY

(SUBUNGULATA).

The South American family of the agoutis is distinguished from all the other families by the peculiar structure of the toes, which instead of nails or claws carry a sort of hoofs. This structure of the toes is very conspicuous in the largest member of the family, and indeed the largest of all rodents, the capybara. In this animal the last phalanx on all the toes appears in the skeleton rounded, flat, and spongy, as in the tapirs, and it is encased by a horny hoof, which is likewise flat and rounded. In the other genera this structure of the toes is not so manifest. The hoof stands erect in the form of a ridge or keel, and is prolonged beyond the bony phalanx, only the last part of which is inclosed by it, and as it is also a little curved it presents something of the appearance of a claw. In this family there are accordingly transitional forms, which show that the distinction between hoofed and clawed mammals (Ungulata and Unguiculata) is by no means so fundamental as has been represented.

All the Subungulata have a rather coarse fur, feet naked on the soles, and a mere stump for a tail, often scarcely projecting beyond the

pelvis. The collar-bones are altogether wanting. These animals are extremely stupid and indolent. The development of the ovum and the embryo, if we may judge from the capybara, presents some remarkable peculiarities. The dentition is far from uniform. There are always, indeed, four cheek-teeth in each half of each jaw; but these are so varied in

structure that the family can be divided into two groups in accordance with these differences.

In the first group the cheek-teeth are arranged in two parallel rows, and have distinct roots, which, however, are not completely closed. The surface of the crown when worn flat exhibits intricate folds, so that it acquires the appearance of a coarse fabric which has been



Fig. 231.—The Golden Agouti (*Dasyprocta Aguti*).

lined and then folded twice.

The Agoutis (*Dasyprocta*) belong to this first group. These animals, which have sometimes been called "golden hares," have a thickset body, which is high and arched behind. The muzzle is somewhat blunt; the ears are small and rounded; the legs, especially the hind ones, long and thin, the tail-stump naked. The fore-feet have four toes with broad, strong, slightly curved nails, and a rudimentary first digit covered with a flat hoof; the hind-feet have only three toes, but these are very long and are inclosed in rather long claw-like hoofs. The large incisors are yellow in front; the cheek-teeth have two bundles of simple folds. The species shown, the Agouti Proper or Golden Agouti (*D. Aguti*),

fig. 231, has a pretty thick but coarse fur, the hairs of which exhibit alternate lemon-yellow and dark brown markings, which produce a peculiar shimmering effect when the animal moves. The agouti walks, runs, gallops, and jumps almost like a hare; by day it conceals itself especially in the hollows of trees; except at the breeding season it lives solitary; it makes paths for itself in the forest, and is so eagerly pursued by dogs that the latter will give up any other game in order to

follow up the trace of an agouti. The flesh of these animals is not highly esteemed. In confinement the agouti is peaceable and gentle, but shows no sign of attachment to its owner; in zoological gardens they excite but little interest among the spectators.

The Paca (*Cælogenys paca*), fig. 232, belongs to the same group. Its incisors are orange-coloured in front, and the cheek-teeth have still more intricate enamel folds than those of the previous species. In the skull



Fig. 232.—The Paca (*Cælogenys paca*).

of the paca we are at once struck by the considerable development of the cheek-bone, which is rounded externally, and so large that it hides the back half of the lower jaw. On the outer surface are prominent ridges, such as are also to be seen on the frontal and nasal bones. In the living animal a sinewy skin stretches across the inner side of this bone so as to inclose a cavity at the side of the mouth, into which it opens. Yet the paca does not appear to make use of this pouch as a store for food, and no use has yet been discovered for it.

The paca is a pretty large animal considering that it is a rodent, for it attains the length of nearly $2\frac{1}{2}$ feet. Its general appearance is like that of a young pig; but the head is short, almost spherical, with small ears, blunt muzzle, and a cleft upper lip. The tail is a

mere stump. The strong legs are all five-toed, and the toes are enveloped by large and rather long hoofs. The short coarse and thick fur is yellowish-brown on the back, whitish-yellow beneath. On the sides are five rows of bright yellow spots. The paca lives solitary, or in pairs, in the marshy forests of Brazil and the Southern Antilles. By day it confines itself to the hole which it digs for itself, but by night it is very active. It runs and swims well, and works considerable damage, especially in plantations of sugar-cane and maize and melon fields. Its flesh is the favourite sort of game in Brazil, and is prepared for the table like pork, the hair being boiled off in hot water. The animal is easily caught in traps and snares, into which it is enticed by a head of maize. The paca stands our climate very well, but its introduction

into Europe is not to be recommended, since it eats a great deal, grows slowly, and is not very prolific.

In the second group of the Subungulata the cheek-teeth are composed of narrow flat plates arranged transversely and obliquely and connected by cement, which, however, leaves the

points of junction of the enamel plates free. This structure is specially well marked in the furthest back teeth, and in the capybara it is so pronounced that one might take these teeth for miniature elephants' teeth. As regards structure at least there is no essential difference between the grinding teeth of these animals.



Fig. 233.—The Patagonian Cavy (*Dolichotis patagonica*).

The Patagonian Cavy or Mara (*Dolichotis patagonica*), fig. 233, resembles when standing some hornless antelopes. It has long thin legs of equal length, a rather long body somewhat arched behind, and a short tail almost hidden in the hair. In a sitting attitude, on the other hand, it would be more like a hare, if its ears were not so short. It attains a length of about 20 inches, and is about 2 inches less in height at the shoulders. The incisors are relatively small, and the four cheek-teeth have only a single fold in the middle. The soft thick glossy fur is grayish-brown in colour and has a whitish shimmer on the back and sides. On the belly and the buttocks it is white, and the latter white patch

(the speculum) is surrounded by a black ring. The hair on the belly and underneath the neck is a little longer than elsewhere. The mara inhabits the steppes and deserts of Patagonia. It runs well, and lives in troops under the leadership of an old male. It is remarkably shy, and often hides in the holes dug by the vizcachas. In captivity the mara behaves like a hare. Its fur is much used in making carpets and blankets; its flesh is white and not exactly palatable.

The Restless Cavy or Aperea (*Cavia apera* (*porcellus*)), fig. 234, is very probably the ancestor of our Guinea-pig (*C. cobaya*), which, as has been historically proved, was introduced into Europe from America in the middle of

the sixteenth century. The aperea inhabits the borders of the forests of Paraguay, lives in small troops, and when it comes out to graze early in the morning and in the evening is rendered by its stupidity an easy prey to carnivores, serpents, and rapacious birds. Its length is about 10 inches. Its colour is brown or grayish-brown on the back, light gray or

yellowish underneath. The head with the short broad ears, the thick stumpy body, the short legs with four toes in front, three behind, the bearing, the short trot, everything, in short, is exactly as in our guinea-pig. The dentition also is the same. In the aperea the incisors are slightly yellow, but their size as well as the structure of the cheek-teeth, which are almost divided into two parts by the

double fold of enamel, offer no point of distinction. The skull of the aperea is slightly pointed in front, more rounded behind; the guinea-pig is almost always marked with white, yellow, or brown spots:—these are the only points of distinction, and these are, unquestionably, the result of domestication, such as have been brought about in many other animals by the same means.

The Capybara (*Hydrochærus capybara*), fig. 235, is the rodent which, among all those belonging to South America, shows the most complete adaptation to an aquatic life. It is of the same size and general appearance as a one-year-old pig, for it attains a weight of about 1 cwt., a length of 4 feet, and a height of about 20 inches. It is the largest of all

rodents, and, as is indicated by its Latin and German names (both meaning "water-pig"), is very fond of the water, into which it is always ready to plunge on the approach of danger, uttering at the time a peculiar cry. The thick head with the blunt muzzle and the cleft upper lip carries small ears and inexpressive eyes. The four toes of the fore-feet and

the three toes of the hind-feet have large flat rounded hoofs, and are connected by a web. A stump serves for a tail. The anus and the sexual organs are covered by a fold of skin forming a sort of sack. The strong reddish-brown bristles are, as in the pig, only sparsely scattered over the surface of the body. The dentition is extremely remarkable. The strong white incisors are grooved; the cheek-teeth are



Fig. 234.—The Restless Cavy or Aperea (*Cavia aperea*). page 171.

composed of obliquely placed close-set plates of enamel, which, in the hindmost tooth, are so close together that this tooth resembles that of an elephant, while in those nearer the front of the mouth these plates are arranged like a V lying on its side with the point directed inwards.

The capybara lives in families on the marshy banks of the rivers of South America. It runs little, seldom goes far from the banks, but springs well, and swims and dives with wonderful dexterity. It would lead a quiet life, like the peace-loving and ease-loving, not very intelligent animal that it is, were it not that the large beasts of prey, the huge serpents of South America, large fish, and above all, man, stand constantly on a war-

footing with regard to it on account of its excellent flesh. The animal leads in other respects much the same kind of life as a pig, is fond of wallowing in the mud, and could easily be domesticated among us if it were of sufficient value to make it worth while to do so.

THE RABBIT FAMILY

(LEPORIDA).

This family is distinguished from all other families of rodents by the possession of a small pair of incisors in the upper jaw, not,



Fig. 235.—The Capybara (*Hydrochærus capybara*).

however, placed beside, but close behind the large gnawing teeth. They are rather small and narrow, and form, so to speak, a heel which prevents the lower incisors from penetrating the flesh of the palate when the mouth is closed. They have, however, their own sockets and are rootless like the large incisors. The cheek-teeth are present in considerable number; in the lower jaw there are always five on each side, in the upper the number may rise to six. These rootless cheek-teeth, which are furnished with double rings of enamel, get worn away by long use in such a manner that they assume, especially in the lower jaw, the zygodont character. The skull also exhibits a remarkable peculiarity. The branch of the jaw forming the

cheek is incomplete, and exhibits either a single gap or a series of holes like a lattice. The palate, too, is only slightly ossified. The rabbit family is composed of only two genera, and is distributed everywhere except in Australia.

The Asiatic genus of the Piping or Calling Hares or Pikas (*Lagomys*), of which the most wide-spread species, the Alpine Pika (*L. alpinus*), is shown in fig. 236, will be best characterized if we compare it as regards size and general appearance to a guinea-pig, and as regards its mode of life to a marmot. The members of the genus in general are unequivocally shown to be hares by the above-described double incisors. But their body is thickset; the legs are almost of

equal length, and in each half of each jaw there are only five cheek-teeth with a single fold of enamel. Moreover, the ascending part of the lower jaw has only a simple hole instead of being perforated by several holes. The large incisors are deeply grooved. The piping hares are further distinguished from the ordinary hares by the short oval ears, which are almost naked on the upper surface, and by the entire absence of the tail, the place of which is taken by a small lump of fat. The species selected for illustration inhabits the stony plateaux of the Altai Mountains and other lofty ranges of Central Asia. It is found even at a height of 13,000 or 14,000 feet. Another species prefers the naked steppes of the low grounds. In Quaternary times the piping hares were distributed over all Central Europe.

These small agile rodents live in holes and have no winter sleep. They accumulate regular stacks of hay and herbs, which they protect from the rain with broad leaves. They never retire far from their holes, and like the marmots give warning to each other of the approach of danger by a shrill whistling sound.

The other genus composing this family (*Lepus*) comprises the ordinary hares and rabbits. These are distinguished by their long hind-legs, which are four-toed, while the short fore-legs have five toes, and also by their large spoon-shaped ears, by the six cheek-teeth of the upper jaw, the last of which, however, is poorly developed, and by

their small erect tail. An enormous number of species difficult to distinguish inhabit almost the whole earth. Only those which have a special interest for us are here illustrated and described.

The **Common Hare** (*Lepus timidus (europæus)*), fig. 237, has a rather long body and long legs; its ears are at least as long as its head. It attains a length of about 26 inches,

and is of an earthy gray on the back and whitish on the under parts. It inhabits the plains, hills, and mountains to the height of about 3500 feet, and by day prefers to confine itself to woods and thickets, which it quits in the evening in order to seek its food in the fields. It is particularly fond of juicy plants, cabbages, turnips and other sweet root crops, parsley and clover. The common hare makes no hole for itself; during the winter it buries itself under the snow. It is the



Fig. 236.—The Alpine Pika (*Lagomys alpinus*). page 173.

principal object of chase for the ordinary huntsman. It is a good runner, full of a timid curiosity, but rather stupid. In many districts it multiplies with extraordinary rapidity. When it has been able to feed on plenty of aromatic herbs its flesh is all the more tasty.

The **Alpine, Mountain, or Northern Hare** (*Lepus alpinus (variabilis)*), fig. 238, takes the place of the common hare in the Alps and the Arctic regions. Its winter coat is perfectly white, except the tips of the ears which are black. This animal confines itself principally to the zone between the trees and the limit of perpetual snow; but in winter it betakes itself

to the woods. Its mode of life resembles that of the common hare. The males, during the pairing season, are remarkably ardent, like those of the common hare, and like them, too, are very savage towards their young.

The Rabbit (*L. cuniculus*), fig. 239, has a thickset body, and is in every way smaller

than the hare; its hind-legs are relatively considerably shorter than those of the latter animal. The ears, when laid against the side of the head, do not reach to the end of the mouth. The creature is fond of stony and sandy places where it can make burrows, in which it breeds with considerable rapidity.



Fig. 237.—The Common Hare (*Lepus timidus*).

The rabbit is a destroyer without a rival, doing much damage in forest plantations and fields. Of tame rabbits there is an enormous number of varieties, all due to artificial selection. The flesh of the rabbit is white; that of the hare, on the contrary, rather dark. Fertile hybrids between these two species have been reared.

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE RODENTS.

This order, the richest of all the mammalian orders in genera and species, and at

the same time one of the oldest, might be expected to show rather complicated and remarkable phenomena with respect to its geographical distribution, and the phenomena which it does present under this head may be looked at from various points of view.

We are first of all struck by the fact that two large islands, Australia and Madagascar, are almost entirely destitute of these animals. In these two regions we find only a few representatives of the great family of the mice, and while the three genera represented on Madagascar are absolutely confined to this island, two out of the six Australian genera are found also on the neighbouring continent

of Asia, the other four being restricted to Australia. Since the latter island is otherwise inhabited only by non-placental mammals, the presence of a few rodents cannot but be regarded as a phenomenon all the more striking. The island of Madagascar, on the other hand, occupies an altogether exceptional position from another point of view, inasmuch as it is peculiarly rich in other placental mammals, and contrasts with

other regions also in the peculiarity of its rodents.

The other regions of distribution exhibit very unusual relations. South America is the richest of all the continents in rodents and that which has the most specialized forms. Of the thirty-seven genera represented there, thirty-two belong to it exclusively, three it shares with North America, and the other two genera, those of the hares



Fig. 238.—The Alpine or Mountain Hare (*Lepus alpinus*). page 174.

and rabbits and the squirrels, are genera which are found all the world over. It is manifest, accordingly, that South America formed an independent centre of evolution, whose primitive stocks were different from those of the other parts of the earth.

Such also is the case with the true continent of Africa, which, considered from a zoological, botanical, and geological point of view, comprises only the region to the south of the Sahara. Yet, though this region is almost as rich in forms as South America (there are in it thirty-one genera), it is far from presenting the same degree of specialization; for it has four genera besides the hares and squirrels in common with the Mediterranean region,

other four in common with the East Indies, so that only twenty-one belong to it exclusively.

The Palæarctic Region, notwithstanding its enormous extent, including as it does all the area to the north of the Atlas Mountains and the Himalayas, is more sparingly supplied with rodents than either of the two previously mentioned regions. India being left out of account, Europe and Asia together have only nine, out of twenty-five genera represented in them, peculiar; the other sixteen are shared either with Africa, India, or North America. As in so many other cases, we can in the case of the rodents also verify the fact that the polar regions have a large

number of types in common, a fact most probably to be explained by the supposition that the types in question have radiated in different directions from the extreme north, that portion of the earth having had, even in the Miocene period, a mild climate similar to that of Southern Europe at the present day.

North America is only slightly different from the region just spoken of. Out of its twenty-four genera only eleven belong to it alone; the others are shared by it with South America, or with the Eurasian continent. The types peculiar to it, however, are so sharply specialized that we may regard them as descendants of separate stocks.

It may justly excite surprise that India and the Sunda Islands are so poor in rodents. This region, which is so rich in the other mammals, is so sparingly supplied with rodents that we may well suppose that all the forms represented there are due to immigration. Of sixteen genera known to exist in India and the Sunda Islands only four are peculiar to these regions, three of the four belonging to the mouse family, and one to that of the porcupines; and there is even something arbitrary in the assigning of generic characters to the four genera in question. If the East Indies have in the case of the other orders of mammals contributed many of the primitive stocks, in the case of the rodents it has furnished not one characteristic form; the few types represented there are derived from

other regions. Now this remarkable result can be due neither to the influence of climate nor to deficiency of food, for South America and some parts of Africa, which have the same conditions of existence, are richly supplied with rodents.

We are met with similar peculiar phenomena in studying the distribution of the families. We have already on several occasions directed attention to the fact that the subdivision of the rodents into families and genera is peculiarly difficult, and that investigators still hold contrary opinions as regards this matter. But whatever view one may adopt, one is bound to admit that certain types are remarkably widely distributed, while others are limited to more or less restricted



Fig. 239.—The Rabbit (*Lepus cuniculus*). page 175.

areas. As regards the latter, South America exhibits the greatest amount of peculiarity, for, apart from the northern regions, the two hemispheres are sharply separated from one another, and illustrate that contrast that has often been dwelt on.

There is in fact only a single family distributed over the whole earth, including Australia and Madagascar. This is the remarkably numerous family of the mice, which has adapted itself to all climates. And then there are two others, the hares and squirrels, which are excluded only from the regions mentioned. To the Old World exclusively belong only the mole-rats, the dormice, and the typical porcupines; the beavers, the

jerboas, and the pikas are represented in the Old World and in the colder parts of North America; the warmer zones of the Old World and South America have the octodons and the spiny rats, which are chiefly developed in America. On the other hand, all the Subungulata, as well as the genus *Lagidium*, are purely of South American origin, while the pouched rats and the tree porcupines are natives of North and South America. The New World thus excels the Old in the number, richness, and diversity of its types, and manifestly South America is the most favoured region of all.

This remarkable distribution of the rodents cannot be explained by any peculiarities of climate, food, and so forth, such as are usually erroneously regarded as the dominant factors in determining the distribution of faunas. The poverty of the East Indies in rodents has sometimes been attributed to the large number of small beasts of prey there met with, and to the uniformity of the conditions of existence, which is held to have been unfavourable to the development of varieties. It is not easy to understand how such a conclusion can ever have been arrived at in face of the facts observed in South America, where the rodents are at once most numerous and most varied, notwithstanding the uniformity of the climatic conditions, and notwithstanding the abundance of terrestrial and winged enemies which are found there also.

These differences in distribution, on which we have so often laid special stress, must accordingly be due to another cause, and this can only lie in the origin or descent of the different types. The geographical distribution points us first of all to various centres from which the rodents must have spread; and these centres are unquestionably the two Americas, South Africa, and the Eurasian continent. During the process of distribution over the earth the rodents have naturally undergone greater or less modifications. We must accordingly seek the key to explain the

phenomena observed at the present day in the facts of palæontology.

The Upper Eocene has yielded in Europe the remains of two genera still living, *Myoxus* and *Sciurus*, both of which have continued without interruption to the present day. It is a rather notable fact that of these two earliest known genera one has tubercled teeth and the other enamel ridges on the crown, while in both the teeth have roots. It is also worthy of note that the dormice, notwithstanding their occurrence in very remote epochs, have remained confined to the Old World, while the squirrels, which at the present day are remarkably abundant in the New World, have hitherto yielded no remains in America older than the Quaternary strata. On the other hand, we find in the Eocene of Wyoming two extinct genera, *Paramys* and *Sciuravus*, the latter of which, as the name itself indicates, is closely allied to the true squirrels; and we find, moreover, that there is in the Upper Eocene a genus allied to the marmots, *Plesiarctomys*. The mice are represented in the Eocene of America by the extinct genus *Myops*, and a genus called *Megamys*, belonging to the family of the Octodontida, is mentioned as belonging to the South American Eocene, together with doubtful remains referred to the genus *Arvicola* (the voles). The European genus *Theridomys*, found in the Upper Eocene of Auvergne, would be regarded as the ancestor of the spiny rats.

Mice, dormice, squirrels, octodons, and spiny rats would thus all have their ancestors in the Upper Eocene.

In the Miocene we find a greater wealth of families and genera; only the mice make an exception in this respect, they remaining almost stationary. The jerboas first appear in Europe, represented by the extinct genus *Issyodrimys*; the beaver family makes its appearance with the genera *Castor* (the true beavers), *Chalicomys*, and *Steneofiber* in Europe (the two latter now extinct), and with the extinct *Palæocastor* in America. In India

the porcupines make their first appearance, and the piping hares have been found associated with an extinct genus, *Titanomys*, which, during the Miocene period, inhabited Central Germany and France.

To these families, which are continued right on without interruption, the Pliocene strata add the families of the chinchillas and the Subungulata in South America. The other genera and families are confined in that period to the regions now inhabited by them, and though a great number of still surviving or extinct genera have been found in brecciated Quaternary strata or in caves, it must nevertheless be admitted that the geographical limits were then precisely the same as they are now.

From this series of facts it results that the rodents have mainly been developed in the Miocene period, but that their roots reach as far back as the Eocene. Some American, and indeed, perhaps, even some South American types appeared in Europe at that time. I do not know whether the characters are clearly enough marked to establish this identity satisfactorily.

Is it possible to fix with any degree of confidence on any old type which might be regarded as related to the rodents? The answer to this question must for the present be given in the negative. We can only admit the possibility that the characteristic dentition of the rodents has developed from that of very ancient insectivores or marsupials, possibly connected with *Plagiaulax*, the remains of

which have been found in the Purbeck Beds (Wealden Series—Cretaceous), and recently in the neighbourhood of Reims in France. The occurrence in the Eocene of rodents with tubercled teeth having distinct roots, and an insectivorous type of structure, is in favour of the first supposition, as well as the fact that the aye-aye has in the milk dentition canines which are afterwards shed in order to give place to a dentition of a rodent type. The same thing might indeed have occurred in former geological epochs, and since it often happens in the case of certain insectivores that the canines are replaced by larger incisors, the inference might be drawn that the dentition of the primitive rodents had been modified through the loss of the canines. On the other hand, I confess that the jaws of *Plagiaulax* are, in my opinion, much more similar to those of the rodents than to those of any other type, and that in them I cannot discern the marks of a carnivorous dentition such as Owen professes to have found. The large incisors of this genus of the Purbeck Beds have certainly no resemblance in form to those of a rodent, inasmuch as they are cylindrical and pointed; but these teeth are followed by a wide interval or diastema, and the premolars themselves have a great resemblance to the cheek-teeth of certain rodents, not only in virtue of their position, but also on account of the fact of their being composed of series of transversely placed enamel plates, which get worn away in much the same way as the cheek-teeth of rodents.

THE EDENTATES

(EDENTATA).

Placental mammals with incomplete dentition and rootless teeth without enamel. The free digits carry hoofs transformed into sickle-shaped claws.



It is difficult to find a suitable name and satisfactory distinguishing characters for this order, which is manifestly made up of diverse elements. Linnæus designated them *Bruta*, embracing under this term, however, also the rhinoceroses and other animals without incisors. The name *edentate*, invented by Cuvier and now in general use, does not correspond at all to the actual facts. There are indeed in this group certain animals, such as the ant-bear or tamanoir, in which the teeth are altogether absent, but, on the other hand, there are other animals belonging to this order—for example, the giant armadillo—having more teeth than any terrestrial mammal of any other order. The incisors are almost always wanting, but we know one species, the six-banded armadillo, in which the first pair of teeth in the upper jaw, though exactly like the cheek-teeth in form and structure, are set in the premaxillary bone, and must accordingly be regarded as incisors. As a rule there are no canines, but we find in the unau, a sloth, beautiful strong canines both above and below. These are pointed and sharp, and thus considerably different from the ordinary cheek-teeth. It is true that these teeth fit into one another in a different manner from the canines of other mammals, so that when the mouth is shut the upper

comes in front of the lower, yet this circumstance should not lead to any difference in the naming of the teeth, any more than the fact of a tooth placed in the premaxillary bone agreeing in form and structure with the cheek-teeth would deprive such tooth of the character of an incisor.

But even apart from these details we must acknowledge that all these teeth are constructed on a quite peculiar plan. They show no trace of enamel, and consist solely of dentine overlaid by a layer of cement, which sometimes rises from the part set in the socket a considerable way up towards the crown with considerable thickness. The teeth never have roots; in one genus, *Orycteropus*, they even consist of a number of small prisms united by cement, each of the prisms having a vertical canal filled with pulp. This kind of dentition calls to mind that of certain fishes.

The claws also deserve special attention. In some genera, as in the sloths, they are enormous sickle-shaped sharp implements, flattened at the sides; in others, again, they are broad and well adapted for burrowing in the earth. Their form, however, is a matter of no moment. As regards their structure they are in every case hoofs, that is, they do not merely cover the last phalanx of the toes,

like the claws and nails of other mammals, but envelop them all round. This important distinction clearly separates the edentates from the true clawed mammals, with which they have often been associated.

It is difficult to point out any other general characters. The skeleton, the nature of the skin and its appendages, the arrangement of the limbs, and the structure of the internal organs are all very different in the sloth, for instance, on the one hand, and in the armadillos and the ant-bears on the other hand. The brain is always without convolutions, and relatively to the size of the body and its members must be called small; the fore-limbs are endowed with an extraordinary power of rotation, especially in the sloths; the collar-bone is always well developed; the pelvis likewise peculiar in structure, containing altogether a much greater number of vertebræ than in any other mammals. The movements of these creatures are remarkably slow, and this slowness may probably be attributed to the great subdivision of the arteries, which form the so-called "*retia mirabilia*." The arteries, that is to say, are broken up at the joints into a large number of ramifying or anastomosing branches, which ultimately unite again to form single vessels. The structure of the placenta is so varied that nothing of a general nature can be said about it.

We subdivide this order into three families: the Sloths, the Armadillos, and the Ant-eaters.

THE SLOTHS

(BRADYPODA).

The members of this family have a spherical head and very long fore-limbs. The zygomatic arch is incomplete, and the jugal or cheek bone has a downward process. The tail is either altogether wanting or is a mere stump. The body is covered with strong bristles. The sloths are exclusively a South American arboreal type.

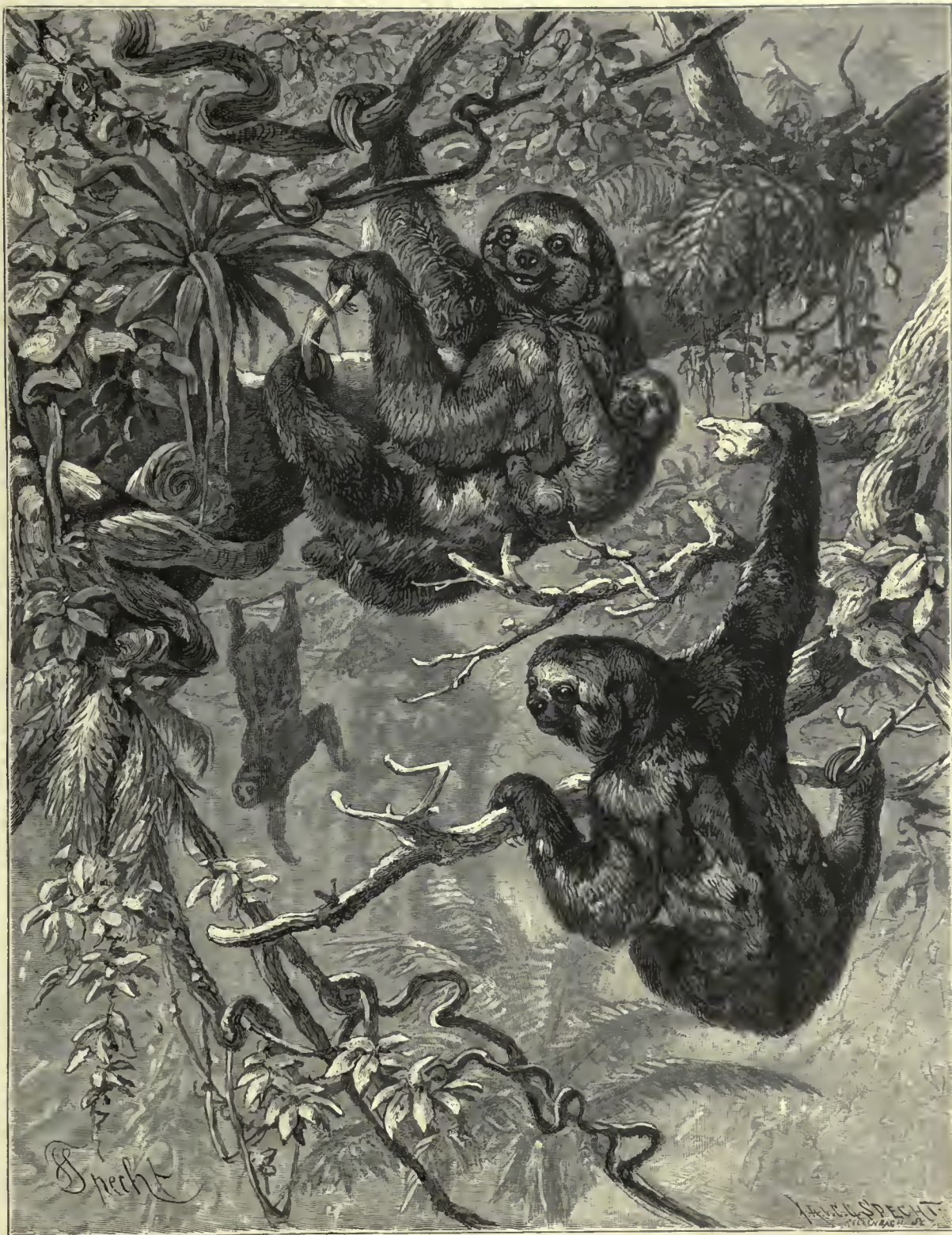
The upper part of the head has a swollen or bulging appearance on account of the exceptionally large development of the frontal sinuses, which extend back even to the occipital region, forming considerable cavities between the plates of the bones of the upper part of the skull. The jaws are rather short, and the two halves of the high and strong lower jaw are completely fused. The zygomatic arch, only the front portion of which is developed, sends a long flat process downwards so as to extend over the outer surface of the lower jaw. The articulations between the head and the neck vertebræ are so free that the creatures are capable of turning the head completely round to the back. As already observed, the fore-limbs are extremely long; thus, in the aï or three-toed sloth, which has a total length of about 20 inches, the humerus or bone of the upper arm measures about 6 inches, the two bones of the fore-arm each about $4\frac{3}{4}$ inches, the hand or fore-foot from the wrist to the end of the claws somewhat more than 4 inches. The humerus is cylindrical and without any ridges for the attachment of the muscles; the two bones of the fore-arm are capable of executing much greater movements of rotation than in man. On account of this great freedom of rotation and on account of the shape of the head some naturalists have proposed to associate the sloths with the monkeys. The hind-limbs are thicker and shorter than those in front; the thigh is cylindrical; there is no third trochanter. In the ordinary attitude of the animal the extremities show the embryonic bend of the soles of the feet inwards; in walking the outer edge of the feet corresponding to the fifth digit touches the ground. The two or three digits which are present carry enormous claws flattened at the sides and shaped like a sabre or sickle. Frequently the metacarpal or metatarsal bones of the other digits are also present. The pelvis is very broad and flat, and the hip-bones unite behind with the sacral vertebræ. The

number of the neck vertebræ, which is so constant in almost all other mammals, varies in the sloths. Instead of seven a species closely allied to the unau or two-toed sloth has only six; the ai or three-toed sloth has nine. In general the skeleton of the sloths is distinguished by great power of movement in the joints; many of the vertebræ resemble those of serpents, and this structure enables the animals to take up the most singular attitudes with the greatest ease, and to perform gyrations and dislocations which would be impossible for other mammals. The tail, which is composed of broad vertebræ, is either short or even quite imperceptible. The body is covered with a coat of long, coarse, stiff hair, so that the animal when crouched up appears like a bundle of hay or dried moss. The direction of the hair is from the ventral towards the dorsal surface, in accordance with the inverted position which these animals so frequently assume. The teeth are simple, without roots, and in both jaws are set so far apart from one another that those of the one jaw fit into the gaps left between those of the other. They usually get worn away by use into obliquely placed transverse ridges. All the teeth are set in the maxillæ or mandibles; the premaxillæ are quite rudimentary. The stomach has three parts like those of the peccaries; there is a paunch and a reticulum with large cells. The œsophagus is continued in the form of a groove to the pyloric region of the stomach. With respect to the sexual organs the sloths stand very near the monotremes and marsupials, but there are teats on the breast.

The sloths are peaceable, sluggish animals, and lead an essentially nocturnal, arboreal life in the primeval forests of South America. They are usually seen singly or in pairs, with head and back downwards, hanging from the branches of trees, to which they cling with two feet, or frequently with only one. Not uncommonly these animals will remain by the hour in the most curious positions without

moving. They move along slowly from branch to branch, and never leave a tree till they have entirely stripped it of its leaves and fruit. By night they become, indeed, a little more active, but even then their movements are slow and deliberate. They get from one tree to another by hooking on to an adjacent branch, without descending to the ground, where their mode of progression is extremely toilsome; in walking they seem as if mowing with their legs. Sloths can endure hunger and thirst for a long time, but not cold. They bring forth only one young one at a birth. Immediately after birth, the young sloth hangs on to the neck of the mother, who carries it about with her. Indolent and stupid, the sloths cling with unparalleled strength to their branches, and defend themselves by their apathy. Nevertheless it has been found possible to domesticate sloths so far that they could recognize the voice of their keepers who brought them their food. But this is all that can be attained. The food is conveyed to the mouth by means of the fore-paw.

The **Ai or Three-toed Sloth** (*Bradypus tridactylus*), which is represented in a full-page illustration (Pl. XXXVIII.), has three claws on all the feet; its neck is cylindrical and rather long, the head spherical and of uniform thickness. The nose is a little turned up. The nearly black face with white rings round the eyes is quite naked. The coarse dry brittle hair begins on the brow, is parted on the back, and forms a ring or collar round the face, to which the small eyes, without apparent pupils, impart a stupid and at the same time rather childish look. The tail is short, measuring in an animal of about 20 inches in length only 2 inches or less. There are five teeth in each half of each jaw, the first being a little smaller than the others; the chewing surface is round and concave. The colour is usually a fallow gray with two light brown but not very conspicuous stripes along the back. The ai lives in Brazil.



To face page 132

PLATE XXXVIII. — THE AÏ OR THREE-TOED SLOTH (*Bradypus tridactylus*).

Other species, recognizable by a black patch on the back, have been combined into a separate genus under the name of *Arctopithecus*.

The Unau or Two-toed Sloth (*Cholæpus didactylus*), fig. 240, is a native of Guiana and Surinam, and at-

taina a greater size than the former species, its total length amounting to about 28 inches. Its head is thicker than that of the aï, the broad muzzle projects, the neck is short, the body slender, and the tail is altogether absent. The olive-brown hair with a shimmer of gray is only a little lighter in colour on the ventral surface than on the other parts. The hair-covering begins at the root of the nose. In both jaws there are strong canines, which are pointed and sharp, and

like the cheek-teeth are covered with a layer of black cement. In section they are triangular. The upper canines are sharpened to a point by friction against the hinder surface, while in the lower ones it is the front that is ground away. The four round cheek-teeth acquire a transverse ridge by use. The fore-feet have two, the hind ones three claws. The number of the neck vertebræ in the unau is seven (the normal number); in an allied species (*Cholæpus Hofmanni*) it is only six.

THE ARMADILLOS

(DASYPODA).

This family inhabits the steppes and bushy parts of South America. The skeleton of

these animals is remarkable for its solidity. The head has the form of a more or less elongated cone, and carries large funnel-shaped pointed ears. Cylindrical simple teeth are always present, often even in considerable number. Only in the six-banded armadillo does the first of these teeth stand, as already mentioned, in the pre-maxilla; in all the others there are only round cheek-teeth, which are sometimes flattened at the sides. They stand at a greater or less distance from one



Fig. 240.—The Unau or Two-toed Sloth (*Cholæpus didactylus*).

another, and get worn away so as to form a transverse median keel. The short tongue is covered with firm horny warts. The zygomatic arch is complete and semicircular in form, and there is no such downward process as is so characteristic in the sloths. The lower jaw is weak and slim. The neck vertebræ, always seven in number, are often fused together, and the second, the axis vertebra, carries a large and high vertical process inclined backwards, so that it resembles

in form the second neck vertebra of many marsupials. The dorsal vertebræ have high vertical processes, and the lumbar vertebræ have in addition to these very high oblique processes. On the expanded ends of these vertebral processes rests the dorsal shield. The hinder portion of the pelvis is remarkably large, and often comprises nine sacral vertebræ; it also has strong processes serving

as supports for the dorsal shield. The tail is long and thick; the vertebræ of the tail likewise carry strong vertical, oblique, or transverse processes as supports for the separate parts of the tail-sheath. The limbs of the armadillos are short, and their bones are provided with well-marked ridges for the attachment of the muscles. The humerus is twisted, the ulna has a prolongation reaching far

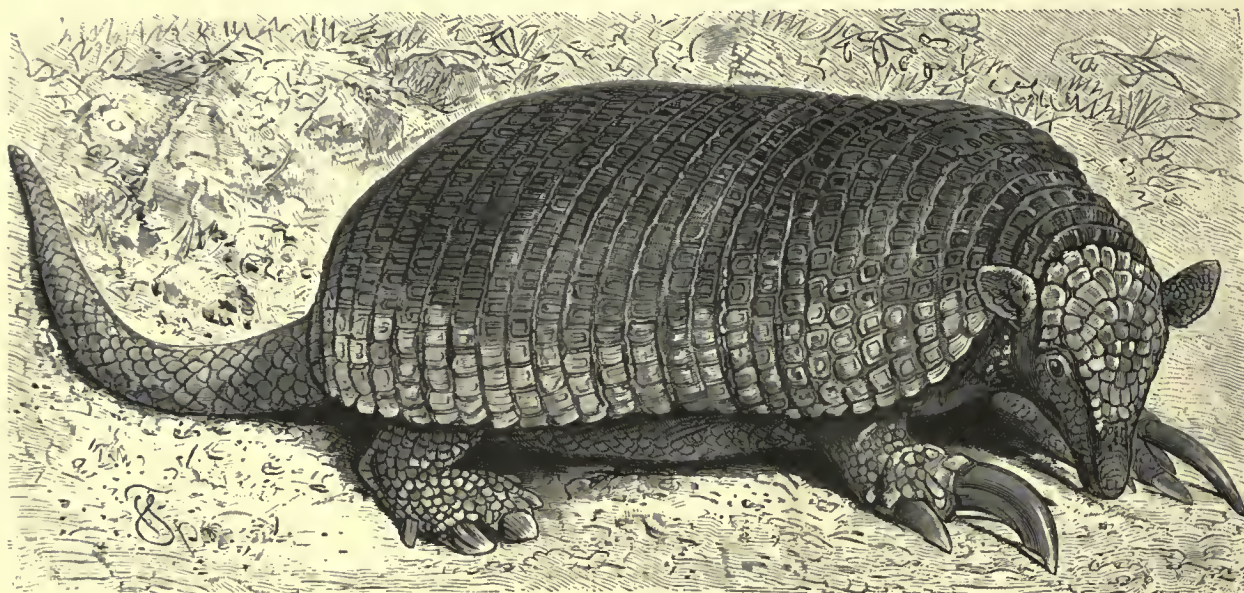


Fig. 241.—The Giant Armadillo (*Prionodon gigas*).

beyond the elbow, and the thigh has a third trochanter. While the bones of the fore-legs enjoy a great degree of mobility, the tibia and fibula are fused at the ends and separate only in the middle. The toes are armed with stout burrowing claws. The ribs are often so broad that their edges touch or even overlap one another.

The most remarkable character of the armadillos arises from the development of a dermal skeleton composed of small plates, mostly hexagonal, laid edge to edge, and adorned with peculiar markings on the surface. These thin plates, which in the living animal are flexible, are composed of true bone tissue overlaid with a horny covering. In most cases they form a series of three shields, one for the head, a second for the shoulders, and the third for the hinder part of the back. The two latter are separated

by transverse bands varying in number. These transverse bands are connected together by a flexible integument, so that the animal can easily enough bend the head and back, and can even roll itself up into a ball. The tail is usually complete and surrounded by plates arranged in rings. The sides of the head, the neck, and the limbs are covered with isolated plates or horny scales belonging to the epidermis. On the belly there is only a firm, tough skin, almost naked. Between the plates and on the edges of the dorsal shields are to be seen strong bristles frequently grooved in rings.

All armadillos live in holes in the ground, which they excavate with remarkable rapidity, and which they never leave voluntarily except at night. They then go out in search of their food, which consists of all kinds of things. They devour everything that they

can find upon or under the earth, and it is even asserted that they attack the dead bodies in the cemeteries. Their flesh is highly esteemed, and the animals are caught by surprising them with well-trained dogs after they have left their holes. They are remarkably strong, and as soon as one of them has got half its body under the earth it is impossible for a man to pull it out by the tail. In general they run slowly; only the young animals trot like guinea-pigs. From the

large number of species distributed throughout South America we select two of the most characteristic.

The **Giant Armadillo** (*Prionodon* (*Priodontia*) *gigas*), fig. 241, is not only the largest but also the rarest of the armadillos. It inhabits the forests north of Paraguay, attains a length of more than 3 feet, and is remarkable for the enormous number of its teeth, which may reach a hundred. They are all simple. Its armour consists of quadrangular plates ar-

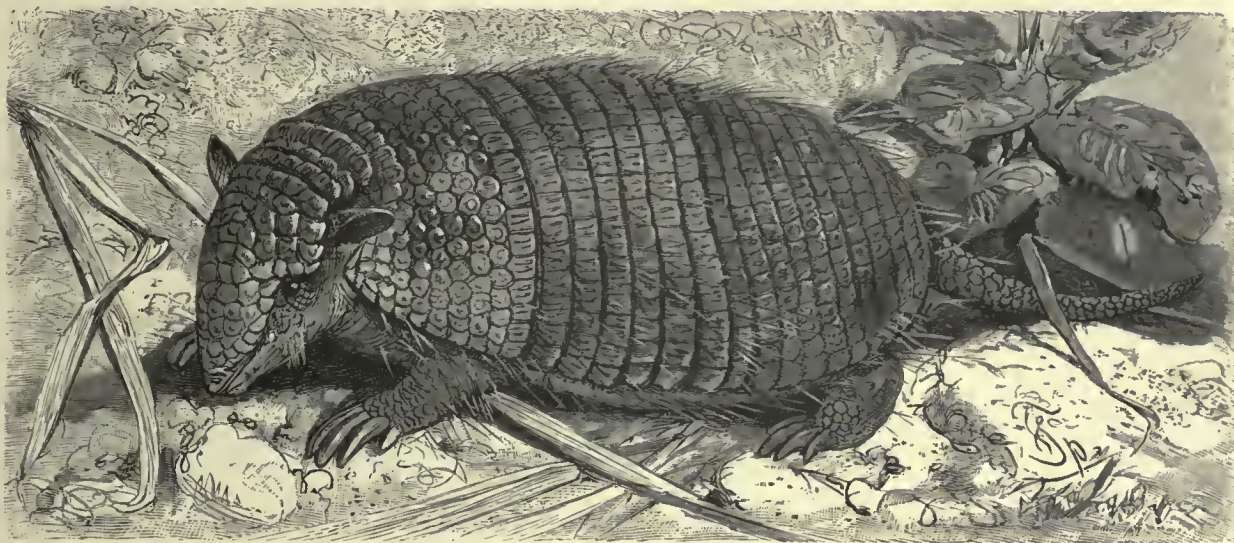


Fig. 242.—The Six-banded Armadillo or Poyou (*Dasyus sexcinctus*).

ranged in bands. The thirteen middle bands are movable. The middle claw of the fore-foot is of enormous size. The thin tail grows to the length of about 20 inches.

The **Six-banded Armadillo** or Poyou (*Dasyus sexcinctus*), fig. 242, has, as its name indicates, six broad movable bands of quadrangular plates, while the dorsal shields are composed of hexagonal plates. The body of this animal attains a length of 16 inches, the tail about 8 inches. In the upper jaw there are nine teeth on each side, the first of which is set in the premaxilla; in the lower jaw there are ten on each side. This animal is extremely abundant in the Pampas.

One of the most remarkable types of this family is the **Pichiciago** (*Chlamyphorus truncatus*), fig. 243, which inhabits the stony desert plains of the provinces of Mendoza and San Luis (Argentine Confederation).

This little animal attains a length of about 5 inches, and has a tail rather more than 1 inch long, which expands at the end. The whole of the upper surface of the body from the forehead to the hinder quarters is covered with a coat of armour composed of rectangular plates, movable on one another and arranged in transverse rows. Immediately behind this dorsal armour comes a firm bony plate or shield covering the hinder quarters and very elegantly decorated. This hind-shield is fused to processes of the pelvis, and has the form of the segment of a round concave shield, the segment being about two-thirds of a circle. The tail projects from a slit beneath this shield. The head is exceedingly short, and is conical in form, pointed at the muzzle, and arched behind. On the forehead of the bony skeleton stand two wart-like elevations of considerable size. Notwith-

standing the small size of the animal the bony skeleton is of remarkable solidity, and especially in the fore-limbs, which are armed with five enormous sickle-shaped claws. The hind-feet are likewise five-toed but less strong; the pelvis is of considerable size. The flat and twisted humerus and femur, both bearing well-marked ridges for the attachment of the muscles, as well as other peculiarities of the skeleton, give this dwarf more resemblance to the extinct giant forms *Megatherium*, *Scelidotherium*, and *Glyptodon* than to any other living animal. The pichiciago lives in underground holes.

THE
WORM-TONGUED
EDENTATES
(VERMILINGUIA).

The principal feature in this family is a tongue of extraordinary length. This tongue is always covered with very viscous saliva, which enables it to serve as an organ of prehension. The long weak jaws are in most cases without teeth, and when closed form a sort of tube in which the tongue plays. The opening of the mouth is usually very small.

The **Earth-hogs** (*Orycteropus*) are natives of Africa, and having shorter and stronger jaws than the other members of the family, having these jaws occupied by teeth, and having besides a wide mouth and a strongly built skeleton, form in a manner a transition from the armadillos to the ant-eaters. Naturalists are not yet agreed as to whether the forms belonging to this genus, forms extending to Abyssinia on the one hand and to the Senegal on the other hand, are to be

regarded as different species or merely geographical varieties. The form represented, fig. 244, the **Aard-vark** or Cape Ant-bear (*Orycteropus capensis*), is found, as the name implies, at the Cape of Good Hope. This creature, with its arched back, its long and sturdy hind-legs, and its powerful tail, on which it is in the habit of sitting erect, has a



Fig. 243.—The Pichiciago (*Chlamydochorus truncatus*). p. 185.

slight resemblance in form to the kangaroo, but its remarkably strong fore-limbs and its head drawn out into a long snout like that of a pig have no resemblance whatever to the corresponding parts of the marsupial just mentioned. The nostrils are surrounded by a fringe of bristles; the very large naked pointed ears are narrow and funnel-shaped. The feet have four toes in front and five behind, and all the toes have strong flat claws surrounding the last phalanx like hoofs, and provided with sharp cutting

edges. In the upper jaw there are eight, in the lower six cheek-teeth on each side, but some of these drop out as the animal increases in age. The peculiar structure of these teeth we have already described (p. 180). The grinding surface is tubular in section. The thick skin is sparsely covered with stiff hairs, which are rather longer on the belly and legs than on the other parts.

The aard-vark preys on ants and termites. Like the other ant-eaters it burrows in the mounds of these insects and shoots out its tongue among the ants swarming in the galleries. It pays no heed to bites or stings, and when it has got its sticky tongue sufficiently loaded with insects it withdraws it to

swallow its prey. But though ants and termites are its favourite food, it by no means despises other larger insects or even eggs and small vertebrates. On the approach of danger it burrows with remarkable strength in the ground in order to escape. Its dwelling consists of a roomy chamber, which it

leaves only at night. The aard-vark attains the length of $6\frac{1}{2}$ feet. Its name, meaning *earth-hog*, it owes to the Dutch settlers at the Cape, who thought that its flesh resembled that of a young pig. For the sake of this flesh, as well as its hide, which yields an excellent leather, it is much hunted.



Fig. 244.—The Aard-vark or Cape Ant-bear (*Orycteropus capensis*).

All the other worm-tongued edentates have no teeth at all. The mouth is in general very small, the lower jaw long but weak.

The True Ant-eaters (*Myrmecophagida*).

The members of this group are characterized by their very thick hair covering. Several genera are distinguished.

The **Great Ant-eater** or Ant-bear, the Yurumi of the inhabitants of Paraguay (*Myrmecophaga jubata*), which is represented in a full-page illustration (Plate XXXIX.), is the largest species. Its body measures about 4 feet 3 inches, the tail with the hair nearly a metre (3 feet 3 inches). The creature has a very peculiar form, but is by no means ugly, as many naturalists assert.

The long thin head is cylindrical in shape and has a scarcely observable curvature; the mouth is so narrow that a finger just fits into it; eyes and ears are both very small. The short legs have four toes in front and five behind, all the toes armed with large sharp sickle-shaped claws. The fore-paws are so twisted and curved that in walking or running they touch the ground only with the outer edge. The animal is specially distinguished by its splendid bushy tail with long hair like that of a horse. The tail is carried erect over the back. The rest of the body has a luxuriant growth of coarse shaggy hair; a mane hangs down from the back on both sides. The whole animal is in fact little more

than a mane. The general colour is very dark, almost black; a jet black horizontal stripe extends from the neck across the shoulders and along the back, terminating in a point at the hips. It is fringed by white hairs of considerable length, especially on the fore-legs. There is further a white line on each side of the brow parallel to the edge of the black stripe.

By day the yurumi roams about in the steppes in search of ant-hills, while by night, since it makes no burrow, it creeps among the bushes to sleep. Its sense of smell is very keen, but the other senses are only slightly developed. It sometimes defends itself by embracing its antagonist like a bear, and inflicting wounds with its sharp claws. The great ant-eater is now to be seen pretty frequently in zoological gardens; it ultimately learns to know the voice of its keeper. An allied species, the *Tamandua* (*Tamandua tetradactyla*), is a good climber, and has a prehensile tail scaly at the end.

The **Little Ant-eater** (*Myrmidon* (*Cyclothurus*) *didactylus*), fig. 245, is a small creature, arboreal in its habits, measuring only 8 inches, and having a prehensile tail of the same length. The moderately long head is spherical in shape, and has a short but pointed snout; the tongue is likewise rather short, the whole body is thick and rather long. The short but strong paws carry two large sickle-shaped claws in front and four of the same kind behind. The ribs are very broad so as to overlap at the edges. The cylindrical body is clothed with thick soft woolly hair,

which is reddish-yellow on the back, and more of a gray colour on the under parts.

The little ant-eater is a nocturnal animal. It climbs about on the trees like sloths, with this difference, however, that it is aided in so doing by its powerful tail, which it twines round the branches. Like the sloths it sleeps either clinging to a branch or crouching on its hind-legs. It is a native of the primeval forests on the banks of the Amazon and the Orinoco. I have received a specimen from the island of Trinidad, but it was not certain whether it had not been brought over from the mainland.

The Pangolins or Scaly Ant-eaters.

This group, forming the genus *Manis*, are ant-eaters which have their body covered with scales overlapping one another like tiles on a roof (imbricated scales). And this is the chief



Fig. 245.—The Little Ant-eater (*Myrmidon didactylus*).

distinguishing character of these animals, for as regards their bodily structure they entirely resemble the true ant-eaters; their skeleton, their toothless mouth, their worm-like tongue, and their in-turned fore-paws are all exactly like what we find in the latter animals. The pangolins are natives of Africa and the East Indies. The scales, which are formed of a firm horny mass, are round or rhomboidal in form at the free part, which, as in fishes, covers the front portion of the next scale. The markings on the surface of the scales appear to indicate that these are composed of fused horny fibres. They cover the whole of the body and tail with the exception of the abdominal surface and the inner sides of the



To face page 188.

PLATE XXXIX. — THE ANT-BEAR OR GREAT ANT-EATER (*Myrmecophaga jubata*).

legs. The pangolins are nocturnal in their habits. They have a singular habit of frequently running only on their hind-legs, balancing their body with their tail while so doing. They also climb very well. Their

food is the same as that of the true ant-eaters.

An illustration is given of the **Long-tailed Pangolin** (*Manis longicaudata*), fig. 246, which is a native of Guinea. Its tail is



Fig. 246.—The Long-tailed Pangolin (*Manis longicaudata*).

even longer than the body, and the paws are only slightly hairy. The **Short-tailed Pangolin** (*Manis pentadactyla*), fig. 247, has

very broad scales, a shorter tail, and short legs completely covered with scales. With respect to the form of the body this creature

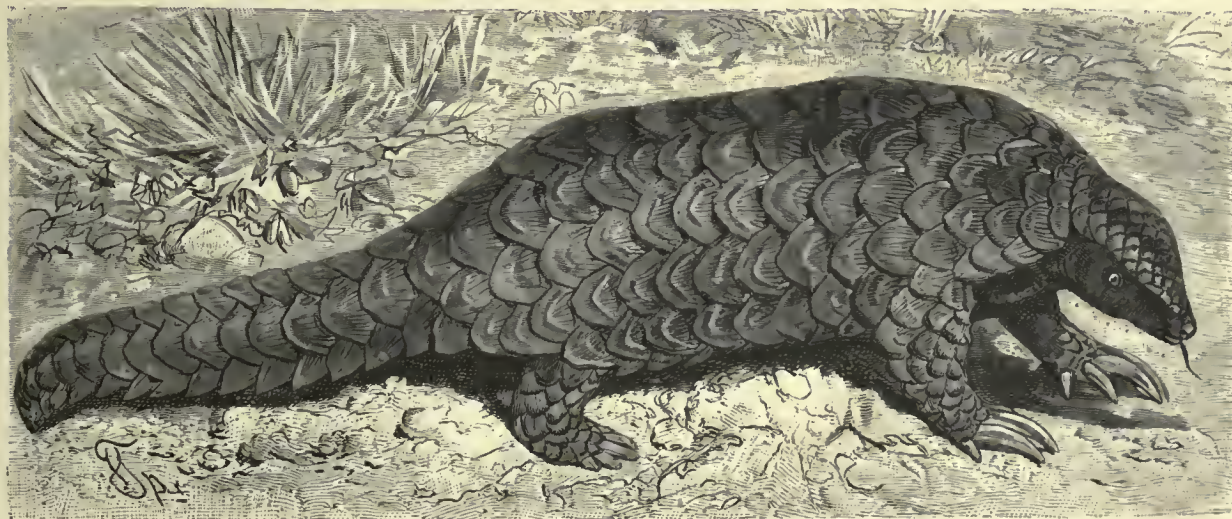


Fig. 247.—The Short-tailed Pangolin (*Manis pentadactyla*).

is exactly like a squat lizard with short legs, for instance the skink. This pangolin inhabits India and Ceylon.

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE EDENTATES.

The geographical distribution of this order is extremely simple. At the present day

we find only two groups of them in the hotter parts of the Old World. One of these, the **Pangolins**, spread over the whole of Africa south of the Sahara, as well as over the East Indies, including the Sunda Islands, as far as China, while the other, that of the **Earth-hogs**, is confined to Africa. All the other families, the **True Ant-eaters**, the **Armadillos**, and the

Sloths are found solely in South America, with the exception of a very few species which extend into Central America.

Nevertheless this simple geographical distribution has something unusual in it. The pangolins of the East, notwithstanding their armour of scales, resemble the true ant-eaters of America, which are only clothed with hair, but like them are entirely without teeth; the earth-hogs of Africa, on the other hand, have a certain though no doubt rather distant resemblance in their teeth and the form of the head to the armadillos. Manifestly, however, these Old World forms stand in no direct relation to those of South America.

The oldest types of the edentates that we know do not reach further back than the Upper Miocene. In that period Greece was inhabited by a giant genus, *Ancylotherium*, France and Germany by one scarcely less gigantic, *Macrotherium*, the latter with rather long and slender limbs. The structure of the teeth in the latter is somewhat similar to that of the earth-hogs; and the giant of Pikermi, the *Ancylotherium*, is also placed beside this genus, which since the Miocene period must have moved southwards till at last it came to concentrate itself entirely in Africa.

Subsequent to the Miocene period the Old World has no edentate remains to show so far as is yet known. It is probable, indeed, that Africa will yet yield such remains when that continent has been as thoroughly explored as Europe has been already. On the other hand, the most curious types have been brought to light from the Pliocene and Quaternary strata of America.

The Pliocene of California incloses the remains of a gigantic genus, *Morotherium*; the Quaternary caves of the eastern parts of the United States contain another, *Megalonyx*; but most types have been yielded by the Pleistocene and Quaternary strata of the Pampas and the caves of Brazil. The forms derived from these regions are extremely

numerous, and many of their skeletons have been preserved in their smallest details.

It is incontestable that these fossil forms, now entirely extinct, fall into two groups, that of the armoured **Glyptodons** on the one hand, and that of the **Megatheriums** (*Gravigrada*) on the other hand, the latter of which had a naked skin, or a skin covered only with hair. The former have been ranked with the armadillos, the latter with the sloths, and a single genus, of which very little is known, called *Glossotherium*, has been regarded as allied to the ant-eaters. No direct ancestor of the sloths has yet been found, however, and the armour-clad glyptodons cannot be brought into any direct relation with the armadillos, for true armadillos have been found in the same strata with them. I have myself had under my eyes a proof of this fact, for the museum at Geneva possesses the skeleton of a true fossil armadillo, which unfortunately is too completely incorporated with the rock in which it is embedded to be capable of being entirely restored.

Certain it is, however, that these fossil types exhibit singular combinations of characters. All of them, whether armour-clad or not, show in the structure of the skull and of a number of other parts of the skeleton the essential characters of the sloths; to give only one instance, all of them have the typical downward process from the cheek-bone. Further, they are all provided with teeth, which are in some cases sharply distinguished from those of the sloths and armadillos. On the other hand, not a single fossil genus possesses the slender elongated limbs of the sloths; the limbs of the unarmoured, as well as the armoured forms, have most resemblance to those of the *pichiciago*. The resemblance between the skeleton of the megatheriums and that of the sloths is so great, that even Cuvier called the megatherium, in spite of its clumsy massive legs, a gigantic sloth. On the other hand, the shield of the glyptodons differs considerably from that of the armadillos.

The bands of the latter are always movable, whereas the armour of the glyptodons is rigid like that of the turtles, and is entirely composed of pieces joined together immovably by sutures. The only genus which had a longish head somewhat similar to that of the armadillos, the genus *Scelidotherium*, had no armour.

We can thus trace neither the present armadillos back to the glyptodons nor the

megatheriums back to the sloths; but it is no doubt with justice that the edentates have been reckoned as a degenerate branch of the ungulates. Moreover, a certain affinity to the monotremes may be admitted, since they approach these in the structure of the brain and limbs. On the whole, however, we must confess that we are so far confined, from the want of an adequate basis of facts, to more or less bold hypotheses.

THE MARSUPIALS

OR POUCH-BEARING MAMMALS

(MARSUPIALIA).

Non-placental mammals, with free digits bearing nails or claws. The young are born in a very imperfect condition, and complete their development attached to teats situated in an external abdominal pouch (*marsupium*) supported by two special bones (*marsupial bones*) attached to the pelvis. The dentition is usually complete but permanent, except in the case of a single premolar, which is shed and renewed. The lower angle of the lower jaw behind is turned inwards.



The marsupials form along with the next order, the monotremes, a separate group of mammals, distinguished by characteristic features in the mode of reproduction. All other mammals produce in the ovary eggs of microscopic size, which, after leaving the ovary, get lodged in the uterus or womb, with the aid of a separate organ called the placenta, formed partly from the egg itself and partly from the walls of the uterus. By the rapid circulation of the blood in this organ the necessary materials for the growth of the embryo are supplied to the egg, and it is only by the constant exchange between the blood of the mother and that of the embryo that the development of the latter is rendered possible. Now nothing of this kind takes place in the two orders mentioned, which have no placenta and are hence called **non-placental mammals**. As in the Amphibia, the eggs in these orders contain in themselves all the materials requisite for the development of the embryo, and the latter does not enter into relations with the organs of the mother, but receives further supplies of the materials required for the growth of the embryo only from the fluids contained in the

maternal organs. Among the marsupials this embryo, which always lies completely free in the uterus, is extruded in a very undeveloped condition, but yet in a condition so far advanced that it is able to obtain further nutriment for itself by sucking the teats of its mother, which secretes a very abundant supply of milk. The small size of these embryos at birth is something extraordinary. The young of the great kangaroo, which when full-grown is as large as a man, is even less than an inch in size at the time of its birth. In the case of the monotremes a perfect egg with a thin shell is extruded.

While, on the one hand, the relations between the young and the mother are not the same in the marsupials and monotremes, there are also considerable differences in the further development of the embryo. The monotremes possess, indeed, separate marsupial bones, but there is formed for the egg and the embryo which proceeds from it only a temporary brood-pouch, into which the milk-glands open directly without teats; in the marsupials, on the other hand, we find for the most part numerous and often very long teats, these teats being situated on the

abdomen, and either surrounded by simple folds of the skin, or contained in an actual pouch. This pouch has only a single opening, usually in front, but sometimes, as in the pouched badgers (*Peramelida*), behind. It is nothing but a fold of the skin, and has no connection whatever with the abdominal cavity. In the ordinary position of these animals, on their four feet, the marsupial bones protect the pouch from the pressure of the abdominal viscera, imparting as they do greater solidity to the walls of the abdomen. According to the observations made in zoological gardens the mother takes the young one by the mouth immediately after birth, and attaches it to one of the teats in the pouch; the young one then remains hanging there for a longer or a shorter period; and even afterwards, when it is able to move about freely, it frequently seeks refuge in the pouch, which, however, it ultimately leaves for ever.

This peculiar mode of reproduction naturally involves a considerable number of modifications in the structure of the sexual organs; but on these we do not enter at present. They are associated with other characteristic features in the general organization, with the aid of which it is always easy to distinguish a marsupial, notwithstanding the considerable divergences existing among themselves.

We must lay great stress on the fact that the marsupials do not form an order in the sense in which the word is used with reference to the other (the placental) mammals, but rather a large group, composed of a number of divergent types, each of which forms an order by itself. In this group we find carnivores, rodents, insect-eaters, and herbivores, all well characterized, and this diversity of types can be understood only when we regard the marsupials of the present day as the relics of an old order of things, in which the entire class of the mammals was represented solely by marsupials over the whole earth. As we are taught by the facts

of palæontology, the former marsupials were the stocks from which, on the one hand, the placental mammals were evolved; while, on the other hand, their less modified descendants form the marsupials of the present day. We need not be astonished, therefore, when we observe that these descendants have preserved a number of primitive characters, and that they occupy a very subordinate position with respect to the other orders of mammals.

The brain and the part of the skull inclosing it are unusually small in relation to the bones of the face and the jaws. The brain, which is itself small, exhibits positive marks inferring a low stage of development. The hemispheres are smooth and never cover the cerebellum. In most cases the corpora quadrigemina also remain uncovered; only in the large species are there to be seen a few faintly-marked convolutions on the hemispheres. The corpus callosum, which is so highly developed in the placental mammals, consists in this group only of a few unimportant fibres. The bones of the skull are not fused. The lower jaw always shows an inflection of the posterior angle inwards. This last characteristic feature does not belong exclusively to the marsupials, for I have also observed it in certain American rodents—in the ursons of North America (*Erethizon*) and the Mexican souslik (*Spermophilus mexicanus*). As a peculiarity of the skeleton we may mention the marsupial bones. These are two bones, mostly cylindrical in shape, united to form a sort of fork, which is attached to the pubic symphysis.

The dentition exhibits considerable modifications. In comparison to the placental mammals the number of the teeth is in general very high. In the carnivorous and insectivorous marsupials we often find an extraordinary number of incisors and cheek-teeth; in the former the canines are always developed, and the number of carnassial teeth may be as many as three. But although in the groups mentioned we find three or four

sorts of teeth represented, incisors, canines, premolars, and molars, it ought to be borne in mind at the same time, that in the herbivorous marsupials we meet with the same instances of reduction in the number of teeth and specialization of their structure, which have been shown to take place in the placental mammals. These modifications affect especially the incisors, canines, and premolars, and may lead in the end to the formation of a rodent dentition. With very few exceptions the marsupials have four cheek-teeth both in the upper and lower jaw on each side of the mouth, while the number of premolars may be reduced from three, the original number, to two, or even one. The forms of the teeth vary in a remarkable degree, but with a few rare exceptions the cheek-teeth have double or treble roots, and in this respect are in no way different from the best characterized teeth of the placental mammals.

There is, however, a fundamental distinction as regards the origin and development of the teeth. According to the discovery of Flower the distinction between the milk and the permanent dentition consists in this, that only a single premolar is exchanged—shed and replaced. It does indeed happen, for example, in the case of some kangaroos, that, as in the elephants, the front molars are extruded by a rotatory motion of the hinder ones as they grow, but a regular exchange of the front cheek-teeth belonging to the milk dentition for others belonging to the permanent dentition, such as takes place in the placental mammals, does not occur except as regards the single tooth referred to. This is an important character, which, as we have already had occasion to mention in treating of the Carnivora, has served as a means of distinguishing the extinct hyænodons from the marsupials.

The feet also undergo various modifications. It cannot be repeated too often that the original form of the foot is that with five distinct toes provided with nails. All forms

with a smaller number of toes and with hoofs are departures from the primitive type due to a one-sided development. The divergence of the thumb or great toe, which may proceed so far that this digit may become capable of being opposed to the others, is likewise a primitive formation represented from the first in a very pronounced manner in all mammalian embryos. The result is that most of the marsupials still retain the original form of foot, that is, five toes with nails, and some groups, such as the phalangers and the opossums, possess an opposable great toe on the hind-feet. Reduced feet are found especially in the kangaroos and kangaroo-rats; but in these animals the process of reduction follows another rule than in the placental mammals. In the latter it is the first digit that first disappears, then the fifth, then the second, and lastly the fourth, so that at last only the middle digit remains as in the horses, or the middle and fourth as in the ruminants. In the marsupials, on the other hand, the toes get degraded in regular sequence from the interior outwards, from the thumb or great toe to the middle digit, so that the kangaroos come to rest in leaping on the abnormally developed fourth and fifth digits. This is an important distinction with reference to the morphology of the feet.

The body of the marsupials is always covered with thick, mostly soft, seldom coarse hair.

All the other characters belonging to the bodily structure vary considerably according to the kind of life to which the animals are adapted. With a single exception the marsupials are all terrestrial. An American opossum, the yapock (*Cheironectes variegatus*), has feet adapted for swimming, and lives like the otter or rather like the water-shrews. All the other marsupials are climbers, runners, jumpers, or burrowers.

The mental qualities, beyond doubt, stand on a very low level, and do not suffice for the struggle for existence where placental mam-

mals enter seriously into competition with the members of this group. In captivity marsupials generally appear dull-minded creatures, without curiosity and without interest regarding their surroundings. Neither towards man nor towards the companions of their cage do they show the slightest attachment. Most of them are characterized by an astonishing tenacity of life. Among the Americans the opossums have become proverbial on that account.

From the Old World, which was formerly peopled by marsupials, this group has disappeared since Miocene times; at the present day this old and singular group survives only in Australia and America. In the latter area the group is represented only by two peculiar genera. All the other marsupials belong to the Australian region, most of them to the vast island itself, the others to the neighbouring islands of New Guinea, the Moluccas, and the Philippines. With the exception of the dingo, a few rodents, a few bats, and the monotremes, the whole Australian fauna consisted at the time of its discovery of marsupials, which, as we shall afterwards see, form the oldest stock of the entire class of the Mammalia.

We arrange the marsupials according to their mode of life as indicated by the structure of their teeth and feet, and begin with the American genera.

THE OPOSSUMS

(DIDELPHYIDA).

The numerous species of this exclusively American family are found from Patagonia to Canada. In the New World they play in a measure the part of the insect-eaters, which are poorly represented in North America and in South America not at all. They form only two genera, the **True Terrestrial Opossums** (*Didelphys*), and the **Aquatic Opossums** or **Yapocks** (*Cheironectes*), which are confined to South America, and resemble the otters in their mode of life.

The opossums are small nocturnal animals, which attain at most the size of a cat, but are frequently no bigger than a rat or a mouse, which latter they resemble moreover in their general habit. The longish head is pointed, the muzzle set with strong whisker-hairs, the eyes rather small, the ears, on the other hand, pretty large and almost naked. The body is pretty long and rests on short legs. It ends in a long almost naked tail, capable of being rolled up, and mostly scaly like that of the shrews. Almost all the species make use of this tail, like the American monkeys, to attach themselves to branches of trees whenever they wish to do so. The feet are five-toed, the toes themselves free and provided with strong hooked claws. The animals lay the whole sole of the foot on the ground in walking. The great toe of the hind-foot is very strong, very long, and, as in the monkeys, completely opposable. On account of the structure of this hind-hand, so to speak, these animals have sometimes been designated by the name of the "hand-footed" (*Pedimana*).

The dentition answers to the general character of that of the marsupials, inasmuch as it comprises a large number of teeth, and moreover exhibits a remarkable commingling of teeth of a carnivorous with those of an insectivorous type. In each half of the premaxilla there are five recurved pointed incisors, the middle one of which is usually the largest. In the lower jaw we find only four such teeth. The large recurved sharp-pointed canines resemble those of the fox. In each half of each jaw there are, in addition, both above and below, three compressed cutting premolars, each with a double root and triangular crown. So far this kind of dentition might pass for that of a typical carnivore, but in each half of each jaw there are, over and above all these teeth, four true molars, which all exhibit the characters of insectivorous teeth, and especially so in the upper jaw, where the grinding surface presents the characteristic appearance of a **V**, the angle of which is somewhat obliquely

directed inwards. In the lower jaw the molars have each a sharp cusp in the middle with two sharp-pointed side-lobes.

The dental formula is $\frac{5 \cdot 1 \cdot 3 \cdot 4}{4 \cdot 1 \cdot 3 \cdot 4} = 50$ teeth.

The Yapock (*Cheironectes variegatus*), fig.



Fig. 248.—The Yapock (*Cheironectes variegatus*).

248, is the sole representative of its genus, a genus which, as we have already mentioned, is characterized by its aquatic habits and the structure of its hind-feet, in which the long toes are connected by a web reaching to the claws. The first digit is opposable and carries no claw. The claws of the fore-feet are pretty large and sharp.

The head of this pretty creature, which attains the size of a large rat, is tolerably round; the ears are of moderate size, and the long round tail is haired only at the root, elsewhere scaly and only sparsely set with bristles. The hair is very soft, silky, and fine; on the back, round the eyes, and on the muzzle of a chestnut-brown colour, on the sides silver-gray, and on the belly white. The throat also is white, and a light stripe

extends thence to above the eyes, and tapering stripes of brown run from the back to mingle with the gray of the flanks.

The animal is a native of the whole of South America, living on the banks of forest rivers. It is nocturnal in its mode of life; conceals itself by day in holes, feeds on fish, and sometimes gets caught in the nets of fishermen. The female has a complete pouch, which, it may be observed in passing, refutes the theory advanced by some naturalists that the pouch is due to the adaptation of the members of this order to life in arid regions. How could an animal which leads a thoroughly aquatic life possess a pouch if this feature owed its origin to a mode of life directly opposite?

As a representative of the terrestrial members of this family forming the genus *Didelphys* an illustration is given of the Common Opossum (*Didelphys virginiana*), fig. 249, the animal so much detested by the Americans. This is the largest species of its genus, which has been divided into several sub-genera. These sub-genera are distinguished either by having an imperfect pouch, by having, for example, instead of the pouch merely two folds of skin, as in the sub-genus *Philander*, or by having a short, naked, and scaly tail, this appendage being in most forms, as in the species now under consideration, capable of being coiled up. This animal is distributed over the whole of North America from Mexico to Canada. Its body attains a length of about 20 inches and its tail is about equally long.

This hateful stinkard has a very sharp-pointed head and uncommonly large ears. The body and neck are strongly built; the hair is thin and soft, the usual colour a fallow-gray, rather darker on the back than on the under parts.

Like all the members of the genus to which it belongs the opossum leads a nocturnal solitary life. It is a very good climber, employing in climbing principally its fore-paws and its long tail, by the latter of which it often

remains hanging for a long period at once. Birds and birds' eggs form its favourite food. In inhabited districts it often intrudes into the farmyards in order to plunder the poultry-pens, and thereby it calls down upon itself the wrath of the farmers, who pursue it with fury. Its flesh is bad and diffuses a disgusting odour. When the opossum is attacked and wounded it pretends to be dead and rolls itself up, and then the greatest tortures will not suffice to induce it to stir in the slightest degree. The young of this animal, as has been well established, come into the world after a period of gestation lasting only a fortnight, and at birth are blind and without ears. The new-born opossum is only of about the size of a pea, and its mouth forms a sort of tube into which the teat to which it is attached fits. It remains for about two months in the pouch, which the mother keeps constantly closed. When it has grown to about the size of a rat it leaves the pouch for ever. As many as sixteen young ones have been counted in a single pouch.

The distinction between a carnivorous and an insectivorous dentition, which is so well marked in the placental mammals, is much less pronounced in the marsupials, as we have seen above in the case of the opossums. In the Australian marsupials, which are now about to engage our attention, this comming-

ling of dental characters likewise occurs, yet we cannot but recognize the fact that a divergence of type begins to appear, leading, on the one hand, to a perfect carnivorous dentition, and, on the other hand, to one of a purely insectivorous character. All these



Fig. 249.—The Common Opossum (*Didelphys virginiana*).

different types we unite in one group, on which we bestow the name of the Predaceous Marsupials.

THE PREDACEOUS MARSUPIALS

(RAPACES).

THE POUCHED BADGERS

(PERAMELIDA).

The family of the Peramelida or pouched badgers is that in which the dentition most closely resembles that of the Didelphyida; but the members of this family are distinguished from the latter by their general habit and the

structure of the feet. The dental formula would be exactly the same as that of the previous family, if a pair of incisors were not wanting in the lower jaw; instead of four incisors on each side there are only three. The premolars and molars have the same form and are present in the same number, yet the carnivorous type of dentition is less marked

in the front of the mouth. The canines are indeed recurved, but are altogether less highly developed; the lower incisors are inclined forwards. In the upper jaw the fifth incisor is separated from the others by an interval, while the inner ones are all very close-set.

The Bandicoots, as the members of the genus *Perameles* are called by the Australian

the act of leaping. In the hind-legs the great toe (the hallux) is entirely absent; the second and third digits are very thin and united together as far as the claws; the fourth and fifth digits, on the contrary, are well developed, and their claws are powerful. As in all jumpers the ankle (tarsus) is very long. The opening of the pouch in the bandicoots is behind.



Fig. 250.—The Long-nosed Bandicoot (*Perameles nasuta*).

colonists, take in Australia the place of the African Macroscelida or elephant-shrews, which they resemble in the possession of a tapering head running out into a movable proboscis, large ears (mostly naked), short fore-legs, long but strong hind-legs, and long tail, which is seldom thickly haired. Considerable differences, however, are at once recognizable. The great toe of the fore-feet (the pollex) is replaced by a wart or tubercle, which is usually without a nail. The fifth digit scarcely projects at all, but usually carries a flat nail. Only the three middle digits are free and armed with strong claws. The fore-legs are remarkably short, and are pressed close to the breast when the animals are in



Fig. 251.—The Pig-footed Perameles (*Chaeropus castanotus*).

The species represented in fig. 250, the **Long-nosed Bandicoot** (*Perameles nasuta*), is distinguished from its allies by its long proboscis-like nose, its large ears, and the fallow-gray colour of its coarse hair, a colour darker on the back than on the under parts. It lives, like the other bandicoots, in the mountainous and cool districts of Australia, is social in its habits, and digs holes in the ground, into which it darts for refuge when the slightest noise is heard. It catches insects in the act of jumping, and though these form its principal food it does not despise juicy roots, fruits, and seeds. The long-nosed bandicoot is 14 inches long from the tip of the snout to the root of the tail, and the tail measures about 6 inches.

The degradation of the feet has advanced still further in the genus *Chæropus*. The only species represented in this work, the Pig-footed *Perameles* (*Chæropus castanotus*), fig. 251, was formerly erroneously denied to have a tail, because the example first found happened to be maimed in this respect. As regards the structure of the body this animal is a bandicoot, but the fore-limbs are longer and thinner, and have only two long toes with rather short claws. A third toe with a short claw placed very far back is properly only the degraded metacarpal bone. The long and slender hind-foot has only a single strong toe with a solid well-formed claw. Two other greatly reduced toes with extremely minute claws are situated on the outer side, another of similar form on the inside. The middle toe is accordingly the only one that is perfectly developed. The tail is of moderate length.

The pig-footed perameles has long soft hair of a dark brownish-gray colour on the back, rather lighter on the belly; the back of the tail is black. The animal inhabits the steppes on the banks of the Murray River in New South Wales, builds a nest of twigs, and appears to feed chiefly on insects. It attains a length of only about 12 inches in the body, with a tail of rather less than 5 inches.

Between the bandicoots and the following families stands the Banded Ant-eater (*Myrme-*

cobius fasciatus), fig. 252, of which an illustration is furnished. It is an inhabitant of the south and west of Australia, and attains about the same size as the stoat. The dentition of this pretty little creature is very remarkable; it is closely allied to that of

certain marsupials of the Jurassic period. In each half of each jaw there are six molars with several cusps on the crown, three premolars with triangular cusps, and a not very prominent canine. Then there are in the upper jaw four incisors, but in the lower only three, so that the entire number of teeth amounts to fifty-four, a number which is not exceeded by any living marsupial. The dental formula is

$$\frac{4 \cdot 1 \cdot 3 \cdot 6}{3 \cdot 1 \cdot 3 \cdot 6} = 54.$$

The banded ant-eater is a very elegant creature, with a tapering head and pointed paper-cornet-



Fig. 252.—The Banded Ant-eater (*Myrmecobius fasciatus*).

shaped ears. Its fore-feet are five-toed, and the hind-feet carry four free toes armed with sharp claws. In running the animal carries its long bushy tail as squirrels do. The female has no pouch, but has eight teats arranged in a circle. The long thick hair is dark-coloured on the back, and passes behind from a fallow-gray into black. The throat has an ochre-yellow and the belly a whitish colour; on the sides the general dark colour is varied by light transverse stripes. The animal lives chiefly on ants, which it snaps up with its long adhesive tongue.

THE DASYURE FAMILY

(DASYURIDA).

In this family the carnivorous dentition becomes more and more pronounced. For the most part these animals have four incisors in the upper jaw, three in the lower, all close-set, conical, and provided with a cutting edge. The large recurved canines are very prominent, and the four molars have several broad and sharp cusps. Only the number of the premolars sometimes varies; some forms, for example the Tasmanian wolf, have three premolars with sharp triangular cusps; others, like the dasyures proper, have only two of these. The dental formula is

$$\frac{4 \cdot 1 \cdot 2-3 \cdot 4}{3 \cdot 1 \cdot 2-3 \cdot 4} = 42 \text{ to } 46 \text{ teeth.}$$

As a representative of the genus *Phascogale* with forty-six teeth, a figure is supplied of the largest species, the **Brush-tailed Phascogale**, the **Tafa** of the natives (*Ph. penicillata*), fig. 253. It attains about the size of a squirrel, which it likewise resembles in the possession of a long bushy tail. The smaller species have been united in a separate sub-genus, on which has been bestowed the name of *Antechinus*. The members of this sub-genus are characterized by having a shorter tail less thickly covered with hair. Their habits are similar to those of our rats and mice, to which they are about equal in size.

All these animals are agile climbers and

surprisingly quick in their movements; in ferocity of disposition they can be compared only to our polecats and shrews. The smaller species must indeed content themselves with insects and eggs, but the large species, like the tafa, are dreaded enemies of the poultry-yard; they kill for the sake of killing, and intoxicate themselves with blood. They are therefore pursued with fury by the settlers,

who have great trouble in protecting their poultry against these adroit nocturnal robbers.

The middle incisors in the upper jaw of the members of this genus are large and recurved; the canines are slender, and the many-pointed molars have in the upper jaw a triangular form like a V. The short, thick legs have five free toes with curved claws; only the great toe of the hind-foot has no nail. The pouch is sometimes



Fig. 253.—The Brush-tailed Phascogale or Tafa (*Phascogale penicillata*).

well-formed, sometimes rudimentary. The tafa is gray on the back, white underneath, and there are black rings round the eyes. The animal defends itself when attacked with wild fury, and inflicts dangerous bites. Like the opossum it is endowed with a remarkable tenacity of life.

The **True Dasyures** (*Dasyurus*) have only two premolars in each half of each jaw, and consequently forty-two teeth in all. The first three many-pointed molars still retain the insectivorous type, especially in the upper jaw, but the last molar is thin, greatly compressed, and transversely placed.

The long bodies, tapering heads, small,

stout legs, pointed tails, soft, thick, and frequently spotted fur, and the whole bearing give to these marsupials a striking resemblance to the Viverrida, and more particularly to the genets. The fore-feet have five, the hind ones four toes with strong curved claws.



Fig. 254.—The Viverrine Dasyure (*Dasyurus viverrinus*).

These animals creep like Viverrida, roam about by night, and commit great havoc among the weaker animals. Mentally, however, they are not highly endowed, and they are easily caught in traps. The species shown in fig. 254, the **Viverrine Dasyure** (*Dasyurus viverrinus*), has round white spots irregularly distributed over its fur, which is



Fig. 255.—The Tasmanian Devil (*Dasyurus ursinus*).

brown above and rather lighter beneath. The animal is fond of roaming about near the sea-shore, and hunts principally after poultry.

The **Tasmanian Devil** (*Dasyurus ursinus*), fig. 255, was formerly the terror of the settlers on account of the devastation which it wrought

not only in the poultry-yards but even among flocks of sheep, on account of the stupid ferocity with which it would defend itself against men and dogs, and on account of its remarkable tenacity of life. Its name sufficiently indicates the hatred and terror

which the animal inspired, even though it is by no means a large species, measuring only about 28 inches from the tip of its snout to the root of its tail, which is about 12 inches in length.

The Tasmanian devil is an ugly animal, with a thick head, blunt snout, compact body, short, stoutly-built legs, and moderately long

tail. Its coarse hide is quite black except for a white stripe on the breast. Its formidable dentition comprises forty-two teeth, all of which are distinguished by their massive form. They are emphatically the teeth of a beast of prey. The strong canines are sharp-pointed, the two premolars conical. Behind the first three molars, which are



Fig. 256.—The Tasmanian Wolf (*Thylacinus cynocephalus*).

genuine carnassials, there follows in the upper jaw a smaller tubercled tooth, while in the lower jaw the four molars are three-lobed and have a cutting edge. No bone can withstand these terrible shears.

The jaws of the **Tasmanian Wolf** (*Thylacinus cynocephalus*), fig. 256, are armed in the same manner; but there is an additional premolar, and consequently the total number of the teeth is brought up to forty-six. The general habit of this largest beast of prey among the still surviving marsupials resembles that of a dog with a long body and rather short legs. The head has the profile of a greyhound's, with erect ears and very wide mouth.

The length of the animal is rather more than 3 feet, exclusive of the tail, which is about half that length. The tail is round and tapers to a point. The hair is short and far from thick, the colour a brownish-gray on the back, rather lighter underneath. From twelve to fourteen black transverse stripes extend from the back down the sides.

The animal inhabits Tasmania, and leads a nocturnal life. It is very sensitive to light. Formerly it was spread over the whole island and devastated the sheep-flocks of the settlers, who called it "the striped wolf."¹ At the

¹ This name, I am informed, is no longer used, the only names now given to the animal in Tasmania being the "native tiger" or "native hyæna."—TR.

present day it is restricted to the mountainous districts of the interior, and is, in fact, nearly extinct. It is fierce, but stupid, and its pursuit and destruction are accordingly easy.

All other marsupials are to a greater or less extent vegetable-feeders; and the modifications of their cheek-teeth, the reduction

of their canines, and the form of their incisors bear witness to this kind of diet. The incisors are present in large number only in the upper jaw; in the lower jaw there are no more than two in each half, and these are mostly directed horizontally forwards. In this section we distinguish several groups and families.

THE FRUIT-EATING MARSUPIALS

(CARPOPHAGA).

In this group there are in all six vertical incisors in the upper jaw, three in each premaxilla. In the same jaw canines are always present, but these are sometimes absent in the lower. The number of the molars is four, that of the premolars varies. The great toe of the hind-foot (the hallux) is opposable. The second and third digits on these feet are weak and united in a kind of sinewy sheath as in the dasyures. The fore-feet are five-toed. Looking to their nocturnal and arboreal mode of life and their general habit we may say that the Carpophaga hold the same position among the marsupials as the Prosimii among the placental mammals.

THE PHALANGER FAMILY

(PHALANGISTIDA).

This is a family very rich in species. The genera and sub-genera have been distinguished according to the presence or absence of a flying membrane, and in accordance with slight modifications in the dentition. All the members of this family¹ have canines in both jaws, but in some, as in cuscus, these are, at least in the upper jaw, sharp and prominent, while in others they may be scarcely distinguishable from the premolars.

¹ The opossums of the Australian colonists.—TR.

The upper molars are quadrangular, the lower ones oblong; they are all composed of transverse ridges which project in the form of a half-moon both to the exterior and the interior. Premolars and canines are often difficult to distinguish. From this family we select only a few representatives.

The **Squirrel Flying-phalanger** (*Belideus* or *Petaurus sciureus*), fig. 257, belongs to the genus *Petaurus*, of which *Belideus* is a sub-genus, distinguished by having a third premolar in both jaws, while the other sub-genera have only two. The shape of the head, which is round, short, and much expanded behind the snout, the large round eyes, the short erect ears, the soft fur, the long bushy tail, and the patagium, or flying-membrane stretched out between the limbs, give to these creatures a marvellously close resemblance to the flying-squirrels, so that the two might from their external appearance be confounded with each other. An examination of the dentition, or a glance at the pouch, or at the feet, would at once enable us to distinguish the former from the latter. The slightly developed great toe of the fore-feet (the pollex) is opposable, and so also is the great toe of the hind-feet (the hallux), which, however, is very powerful and is provided with a flat nail. The second and third digits are short, weak, and united

together, the fourth and fifth, on the other hand, free. The animals sleep by day and go out at night in search of their food, which is of a rather mixed nature, consisting of plants, insects, eggs, and even small birds. The creatures climb and leap with wonderful dexterity, and at night are just as agile and active as they are sluggish and sleepy by day. The species shown in the illustration is of an ashy-gray on the back, white on the underparts and the edges of the patagium. It is a native of New South Wales, lives socially, and is fond of a sugary diet. The body and tail each measure about 10 inches in length.

[A smaller member of this group is the Opossum or Flying Mouse (*Acrobates pygmaeus*), which is about the size of our common mouse. "The little Opossum Mouse," says Gould, "is a general favourite with the colonists; and well may it be so, for in its disposition it is as amiable as its form is elegant and its fur soft and beautiful; what the dormouse is to the English boy this little animal is to the juveniles of Australia. I have seen it kept as a pet, and its usual retreat in the day, while it sleeps, was a pill-box; as night approaches it becomes active, and then displays much elegance in its motions."—*Introduction to the Mammals of Australia*.]

The **True Phalangers** (*Phalangista*) have the same dentition and structure of the feet, but are distinguished by having a tail capable of being rolled up, mostly naked on the under-

side, and by the absence of the patagium. Like the members of the previous genus they lead a nocturnal life. This genus also has been subdivided into several sub-genera.

The **Vulpine Phalanger** (*Phalangista vulpina*), of which an illustration is given (fig. 258), is a very common species in the forests

of Australia and Tasmania. It attains the size of a cat. Its long bushy tail is naked on the under side only at the tip. The soft thick fur is of a general brownish-gray colour, but on the back assumes a reddish tinge, while on the underparts it even inclines to yellow; the throat is rusty-red. The natives make mantles out of the skins.

Other phalangers, like the cuscus with its

strong canines, extend even to the Moluccas.

The **Koala** or Native (Australian) Bear, sometimes called also the **Pouched-bear** (*Phascolarctos cinereus*), fig. 259, is a form that diverges a good deal from this family. Like the other phalangers it is a good climber, but it has no tail. The body is thickset, the head thick and rather blunt. In its gait and in the appearance of its fur it resembles a small thick-coated bear. Its large ears are hidden by large thick tufts of hair; the short thick legs have toes armed with strong claws, and the feet have a peculiar structure which reminds one of that of the feet of the chameleons. On the fore-feet the two inner toes, the



Fig. 257.—The Squirrel Flying-phalanger (*Belideus sciureus*). p. 203.

thumb and forefinger, are opposable to the | as well as the canines are very small; in the other three, so that the paw forms, as it were, a pair of pincers. The great toe of the hind-feet has no nail, but is very large and strong, and can be opposed to the other toes either alone or along with the two adjoining toes. The dentition is a transition to that of the rodents. The two middle incisors of the upper jaw are remarkably strong and get worn by use so as to form a keel. With respect to the corresponding teeth of the lower jaw they assume the same position as in the rodents. The remaining upper incisors | about with it for a long time on its back.



Fig. 258.—The Vulpine Phalanger (*Phalangista vulpina*).



Fig. 259.—The Koala or Native (Australian) Bear (*Phascolarctos cinereus*).

THE HERBIVOROUS MARSUPIALS

(POEPHAGA).

The members of this group are above all remarkable for their powers of climbing. The fore-legs are very much shortened, but capable of a great variety of movement, enabling them to serve as hands. They are always five-toed and provided with strong claws. The hind-legs, on the other hand, are very long and stoutly built; they carry the whole weight of the body, have no hallux (great toe), and have the second and third digits so slim and so closely united that they might be taken to be one; the fourth digit is long and strong, and like the fifth carries a sharp claw. Of the six upper incisors, which are set far forwards in the mouth, the middle pair are always the strongest and sometimes resemble canines in form. The two lower incisors are directed horizontally forwards. The canines when present are always weak, but usually there are none at all; in the lower jaw they are always wanting. A wide interval separates the front from the cheek teeth. The single premolar is very variable; the four molars exhibit transverse ridges.

Dental formula:— $\frac{3 \cdot 0 \cdot 1 \cdot 1 \cdot 4}{1 \cdot 0 \cdot 1 \cdot 1 \cdot 4} = 28$ to 30 teeth.

The Kangaroos.

When mention is made of marsupials every one is sure to think first of all of the singular forms of the kangaroos, so frequently seen in our zoological gardens. People stare with astonishment at these animals with their small heads and large hinder parts, sitting on their two strong hind-legs and powerful tail as on a tripod, looking about them with erect ears, and perhaps scratching their back with

their fore-paws. They are astonished to see them when eating resting on their small fore-paws, and sticking their long hind-legs between the former in order to glide onwards; and probably still more astonished to see the flying leaps which they are able to take, first resting with their body inclined on their long hind-legs and outstretched tail, and then darting through the air to a great distance, and scurrying through the bushes in a very few leaps. And they are no less astonished when they see the elegant little head of a young one peeping forth from out of the pouch in front, and then, after a few glances round, springing out on the grass, dancing for a little round the mother, and afterwards leaping back head foremost with the greatest dexterity into the pouch, whenever any movement is made to alarm it.

The kangaroos are in fact wonderfully adapted to the arid withered savannahs and prairies of Australia. They formerly inhabited these regions in great herds. Excessively timid, and, at the same time, rather stupid, and not very adroit in resisting their enemies, they nevertheless multiplied rapidly notwithstanding the incessant pursuit to which they were exposed on the part of the natives; but the advance of the Europeans has materially altered the conditions of existence for these creatures, and at the present day the kangaroos have been forced back into remote regions, into which the bush-settlers with their sheep-dogs and fire-arms have not yet penetrated.¹ Besides birds they form the sole

¹ Nevertheless, in some of the pastoral districts of Queensland they are still so numerous and destructive that the Queensland government offers a reward of 8*d.* for each kangaroo and 4*d.* for each wallaby scalp. Wallaby is the popular name for the members of

game of these regions, and although their flesh and skin are of comparatively little value they are nevertheless highly esteemed for the want of anything better.

The kangaroos graze by day and sleep by night—the larger species in the bush and in woods, the smaller ones in holes dug by themselves, which they line with grasses and dry herbs. Their food is essentially vegetable. They graze after the manner of our cattle, and a certain herb, of which the kangaroos are particularly fond, has received from the settlers the name of “kangaroo grass.” When they have torn up the grasses or leaves of the herbs they sit down on their tripod to eat them, in doing which they make use of their fore-paws as hands.

The numerous species have been distributed among several genera distinguished by differences in the dentition and the relative length of the fore and hind legs.

The least abnormal type is that of the **Tree-kangaroos** (*Dendrolagus*) of New Guinea, the commonest species of which, the **Ursine Tree-kangaroo** (*Dendrolagus ursinus*), is shown in fig. 260. Although its legs and feet are constructed on the general type of those of the kangaroos, the disproportion between the fore and hind legs is not so striking as in

other forms, the fore-legs being almost equal in length to the hind ones. All the toes have flattened somewhat curved cutting claws. The upper incisors are almost equal in size, the canines are very prominent, and the premolar is of considerable length. The body and the cylindrical tail are each about 2 feet

long. The coat is dark-brown on the back, light-brown underneath. The members of this genus have become completely adapted to a tree life. They climb well and feed on everything that they can obtain on their airy abodes.

The **Rat-kangaroos** or **Potoroos** (*Hypsiprymnus*) may attain, as in the species shown in fig. 261, the **Tufted-tailed Rat-kangaroo** (*H. penicillatus*), the size of a rabbit or a hare; but usually, as the name indicates, are not so large. They live on the arid hilly savannahs, sleep by



Fig. 260.—The Ursine Tree-kangaroo (*Dendrolagus ursinus*).

day in a warm well-lined hole, are social in their habits, and burrow in the ground in search of roots and tubers. They make use of their long prehensile tail to carry herbs to their nests. The fore-paws are shorter than in the tree-kangaroos, and the dentition also is considerably different. The middle incisors are decidedly larger than the canines, and are sharp and recurved. The surface of the long premolar is notched with deep folds running down from the crown, which is compressed from side to side. The species shown in the illustration is brownish-gray on

the genus *Halmaturus*, which closely resemble the true kangaroos, but are distinguished by having a naked muzzle. The commonest species, the black wallaby, is about 2½ feet in length, exclusive of the tail.—Tr.

the back and sprinkled with white on the belly, and is distinguished by the long tuft of hair on the end of the tail.

The **Rock-kangaroos** (*Petrogale*) have no canines and only slight folds in the premolar. They have become adapted to life in rocky districts, and are remarkably adroit climbers, all the more since their hind-legs are not



Fig. 261.—The Tufted-tailed Rat-kangaroo (*Hypsiprymnus penicillatus*).
page 207.

excessively long. The species shown in the illustration, the **Yellow-footed Rock-kangaroo** (*Petrogale xanthopus*), fig. 262, inhabits New South Wales, and attains a length of about 2 feet. Like its allies it leaves its retreat only at night. The tail, including its large terminal tuft, is as long as the body. The long coarse hair is brownish-gray on the back, whitish beneath; on the rump there is a white, on the brow a black stripe.

The **Great Kangaroo** (*Macropus giganteus*) has been selected as the representative of the kangaroos proper, in which the disproportion between the fore and hind legs reaches its climax. It is shown in a full-page illustration (Pl. XL.). These animals have no

canines, and of the upper incisors the second is considerably smaller than the other two. The premolar is small and flat. The molars show the transverse ridges very beautifully.

The males of the species figured, which is a native of New South Wales, attain in a sitting attitude a height of 6½ feet and are accordingly taller than man. They are a third larger than the females, and their weight may amount to 330 pounds. The coat has a dark brown-gray colour on the back, a lighter shade of the same colour underneath. As in all true kangaroos the fourth digit of the hind-foot is the largest; the sharp claw with which it is armed may become a dangerous weapon, and it is used with effect for this purpose both against men and dogs. The observations made on the reproduction of marsupials mostly relate to this species, so frequently to be seen in our zoological gardens.

[“In Van Diemen’s Land¹ the *Macropus major* forms an object of chase, and, like the deer and fox in England, is hunted with hounds. . . . The following particulars of the hunt have been obligingly forwarded to me by the Honourable Henry Elliot, late aide-de-camp to His Excellency Sir John Franklin, and one of its chief patrons. . . .

‘The ‘Boomer’² is the only kangaroo which shows good sport, for the strongest Brush Kangaroo³ cannot live above twenty minutes before the hounds; but as the two kinds are always found in perfectly different situations, we never were at a loss to find a Boomer, and I must say that they seldom failed to show us good sport. We generally ‘found’ in a high cover of young wattles; but sometimes we ‘found’ in the open forest, and then it was really pretty to see the style in which a good kangaroo would go away. I recollect one day in particular, when a very fine Boomer jumped up in the very middle of the hounds, in the open; he at first took a few high jumps with his head up, looking about him to see on which side the coast was clearest, and

¹ It may be well to explain nowadays that Van Diemen’s Land is an old name for Tasmania, the latter name having been adopted by the colonists when they were allowed to set up for themselves with an independent legislature.—Tr.

² A full-grown male, often of enormous size. “Like the ‘rogue elephants’ of Ceylon, these patriarchs are often solitary, and are generally very savage.”—Gould.

³ Bennett’s Wallaby (*Halmaturus Bennetti*).



To face page 208.

PLATE XL. — THE GREAT KANGAROO (*Macropus giganteus*).

then, without a moment's hesitation, he stooped forward and shot away from the hounds, apparently without an effort, and gave us the longest run I ever saw after a kangaroo. He ran fourteen miles by the map from point to point, and if he had had fair play I have very little doubt but that he would then have beat us; but he had taken along a tongue of land which ran into the sea, so that, on being pressed, he was forced to swim across the arm of the sea, which, at the place where he took the water, cannot have been less than two miles broad; in spite of a fresh breeze and a head sea against him he got fully half-way over, but he could not make head against the waves any further, and was obliged to turn back, when, being quite exhausted, he was soon killed.

"The distance he ran, taking in the different bends in the line, cannot have been less than eighteen miles, and he certainly swam more than two. I can give no idea of the length of time it took him to run

this distance, but it took us something more than two hours, and it was evident, from the way in which the hounds were running, that he was a long way before us; and it was also plain that he was still fresh, as, quite at the end of the run, he went over the top of a very high hill, which a tired kangaroo never will attempt to do, as dogs gain so much on them in going up-hill. His hind quarters weighed within a pound or two of seventy pounds, which is large for the Van Diemen's Land kangaroo, though I have seen larger.

"We did not measure the length of the hop of this kangaroo, but on another occasion, when the

Boomer had taken along the beach and left his prints in the sand, the length of each jump was found to be just fifteen feet, and as regular as if they had been stepped by a sergeant. When a Boomer is pressed he is very apt to take to the water, and then it requires several good dogs to kill him; for he stands waiting for them, and as soon as they

swim up to the attack he takes hold of them with his fore-feet and holds them under water. The buck is altogether very bold, and will generally make a stout resistance, for if he cannot get to the water he will place his back against a tree, so that he cannot be attacked from behind, and then the best dog will find in him a formidable antagonist.

"The doe, on the contrary, is a very timid creature, and I have even seen one die of fear. It was in a place where we wished to preserve them, and as soon as we found that we were running a doe we stopped the hounds just at the moment they were running into her. She had

not received the slightest injury, but she lay down and died in about ten minutes. When a doe is beat she generally makes several sharp doubles, and then gets among the branches, or close to the trunk of a fallen tree, and remains so perfectly still that she will allow you almost to ride over her without moving, and in this way she often escapes. A tolerably good kangaroo will generally give a run of from six to ten miles, but in general they do not run that distance in a straight line, but make one large ring back to the place where they were found, though the larger ones often go straight away."—Gould, *Mammals of Australia*.]



Fig. 262.—The Yellow-footed Rock-kangaroo (*Petrogale xanthopus*).

THE ROOT-EATING MARSUPIALS

(RHIZOPHAGA).

This group is represented solely by the genus of the **Wombats** (*Phascolomys*). Fig. 263 represents the **Broad-fronted Wombat** (*Ph. latifrons*), which is pretty common in South Australia and is likewise often kept in our zoological gardens. It is a large thick



Fig. 263.—The Broad-fronted Wombat (*Phascolomys latifrons*).

plump creature with short legs, a mere stump for a tail, and a thick rounded head. The broad paws have five toes with large claws adapted for burrowing. The dentition is exactly like that of a rodent: two strong, sharp, chisel-shaped incisors form the equipment of the front part of the jaws both above and below. A wide interval (*diastema*) is then followed by a series of rootless cylindrical teeth with a flat grinding surface. The pre-molar consists of a single cylinder, while the true molars are made up of two cylindrical parts fused together. There are no canines.

The dental formula is $\frac{1 \cdot 0 \cdot 1 \cdot 4}{1 \cdot 0 \cdot 1 \cdot 4} = 24$ teeth.

The wombats are the very embodiment of stupidity, or rather of apathy. With their

broad burrowing paws they dig out holes in the earth, in which they remain by day; by night they walk out at a leisurely pace in search of their food. They offer no resistance to ill-treatment; they are obstinate in their indifference, yet they sometimes become furious without any apparent cause. They are content with any sort of food, and endure captivity very well. In Australia their flesh is esteemed as highly palatable. The coarse hair is of a bright yellowish-gray colour.

[“The following notes are from the pens of various authors who have written on the wombat, the earliest of whom was Mr. Bass, in Collins’s *Voyage*. . .

“‘The Wombat,’ says Mr. Bass, ‘is a squat, thick, short-legged, and rather inactive quadruped. Its figure and movements strongly remind one of those

of a bear; its pace, too, is hobbling or shuffling, and not unlike the awkward gait of that animal. In disposition it is mild and gentle, but it bites hard and becomes furious when provoked, and then utters a low cry between a hissing and a whizzing sound, which cannot be heard at a greater distance than thirty or forty yards.' Mr. Bass chased one of these animals, lifted it off the ground and laid it along his arm, as if carrying a child. It made no noise, nor any effort to escape, not even a struggle. Its countenance was placid and undisturbed, and it exhibited no discomposure, although in the course of a mile walk it was frequently shifted from arm to arm, and sometimes laid over the shoulder; when, however, he proceeded to secure it by tying its legs, while he left it to cut a specimen of a new wood, it became irritated, whizzed, kicked, and scratched most furiously, and snapped off a piece from the elbow of Mr. Bass's jacket with its powerful incisors.

Its temper being now ruffled it remained implacable all the way to the boat, ceasing to kick and struggle only when quite exhausted.

"Mr. G. Bennett in his *Wanderings*, speaking of one of these animals kept in a state of domestication at Been in the Sumat country, states that 'it would remain in its habitation till dark, it would then come out and seek for the milk-vessels, and should none be uncovered it would contrive to get off the covers and bathe itself in the milk, drinking at the same time. It would also enter the little vegetable garden attached to the station in search of lettuces, for which it evinced much partiality. If none could be found, it would gnaw the cabbage stalks without touching the leaves. Although this animal is very numerous in the most distant parts of the colony, it is difficult to procure, from the great depth to which it burrows.'"—Gould, *Mammals of Australia*.]

GEOGRAPHICAL DISTRIBUTION AND DESCENT OF THE MARSUPIALS.

The geographical distribution of this group is very simple. The wombats and the members of the genus *Myrmecobius* are entirely confined to Australia and Tasmania; the dasyures, the pouched badgers, the kangaroos, and the phalangers, on the other hand, extend beyond this centre both to the north and west into the islands of the Eastern Archipelago, of which Celebes and New Guinea form the nuclei. The non-placental mammals might thus be regarded as an Australasian peculiarity, were it not for the existence of the opossum family in America from the Hudson and the Missouri through the whole of the United States and Mexico to the southernmost point of the South American continent. Only the Old World at the present day has no marsupials to show.

Yet the Old World has known marsupial forms, and that in very early geological epochs. In order to follow the chain of the marsupials back to the oldest representative of the group,

we must first consider the Quaternary forms, which, like their allies of the present epoch, were confined to the Australian and American regions.

The bone caves of Brazil and the United States have yielded a number of species of opossums closely allied to the true opossums of the present day, if not identical with these.

The *Myrmecobii*, *Peramelida*, and *Phalangistida* have not yet furnished any Quaternary or older remains.

The genera *Thylacinus* and *Dasyurus* are represented in the Quaternary strata of Australia. There has been found, moreover, a genus, *Thylacoleo*, of the size of a lion, which is regarded by Owen as the largest of the carnivorous marsupials, but by Flower and Krafft, on the contrary, as a vegetable feeder standing between the kangaroos and the phalangers. In any case we must await further investigations concerning this extinct type.

Further, the wombats are represented by a species which attained the size of a tapir, while the still surviving species are only about equal to a peccary in size.

But the most remarkable types yielded by the Quaternary strata belong to the family of the kangaroos. Both the kangaroos proper and the rat-kangaroos have left remains in these strata. The genera *Protemnodon* and *Sthenurus*, which have been found on the island of Australia, have great similarity to the tree-kangaroos, which at the present day are confined to New Guinea. But the most curious forms are unquestionably *Diprotodon* and *Nototherium*. The latter genus has teeth with elevated transverse ridges, like the kangaroos, the tapirs, and the *Dinotherium*, but these ridges were very high and sharp. The skull of this animal preserved in the British Museum is upwards of 3 feet in length, and the bones of the limbs give evidence of their having belonged to a long-legged animal with a lower fore-leg capable of being to some extent twisted round like that of the majority of the marsupials of the present day. The lower jaw has a well-marked inflection of the posterior angle. This animal must have been at least as large as an elephant.

The no less colossal genus *Nototherium* appears to have had no incisors, and its cheek-teeth perhaps resembled those of *Diprotodon*. In the remains that have come down to us they are unfortunately worn away to such a degree that no conclusion can be drawn as to the form of the crowns.

We thus see that the Quaternary strata of America and Australia stand in exactly the same relation to the fauna found in the same regions at the present day as the extinct and living placental faunas do to one another in other lands. The extinct genera and species are in general considerably larger than the surviving species. The geographical limits have remained the same, for in America also the Quaternary opossums advanced farther to the north than do those of the present day.

In the exclusively Australian Quaternary strata only marsupial forms have been found among mammalian remains. If, now, we take into account the fact that at the time of the discovery of Australia, that great island contained in addition to marsupials only a few rare bats and rodents, which were perhaps accidentally introduced by man, and that, moreover, in the Australasian region we meet with some other monodelphian or placental forms only in the districts of Celebes and New Guinea, which are inhabited by a mixed fauna, we are necessarily driven to the conclusion that the underlying strata can contain nothing but marsupial remains, and that perhaps we shall some day discover in Australia evidences of an evolution such as we find traces of in other regions in the case of placental mammals in Tertiary times. The marsupials of the present day would thus be only the remains of those old faunas which have preserved the marsupial character in Australia through the Cretaceous period, while in other regions of the earth the transformation of non-placental into placental forms was accomplished during that geological epoch.

We may, indeed, be led to such a conclusion in another way when we consider that the placental mammals are already represented in the earliest Eocene strata by a certain number of types, which cannot be derived from one another, when we bear in mind further that the Tertiary strata in Europe have hitherto yielded but few remains of marsupials, and that the Cretaceous strata have up to the present day revealed no traces of mammals whatever, and when we remember finally that the oldest known mammalian remains belong mostly, if not exclusively, to the marsupials.

The genus *Peratherium*, which is represented by several species in the Upper Eocene of France and England, as well as in the Lower Miocene of Auvergne, is not very different from the opossums of the present day, and may without hesitation be referred

to that group. Very probably other ancestors of the opossums will yet be found in America, still it remains a noteworthy fact that the family is restricted to America, and is not represented in Europe subsequently to the Middle Miocene.

But we must not lay too great stress on the resemblance between the Tertiary European marsupials and those of America. Recent investigations of Lemoine have shown that the genus *Plagiaulax* still lived in Tertiary times in the neighbourhood of Reims. This genus has incontestable affinities to the Australian rat-kangaroos of the present day, and we shall return to them again when speaking of the Jurassic marsupials.

The earliest mammalian remains of any kind are small teeth, which are found in the transitional breccias of the New Red Marl (Keuper) belonging to the Triassic strata of Degerloch near Stuttgart, and in a bone breccia near Frome in England manifestly belonging to the same period. To these remains the name of *Microlestes* has been given. These isolated small teeth resemble most closely those of the genus *Myrmecobius* among still living forms, and those of *Plagiaulax* among extinct genera, and on account of this resemblance these remains have been regarded as belonging to a small insectivorous marsupial. A lower jaw found in North Carolina and referred to a marsupial called *Dromatherium sylvestre* is much more complete; it shows seven three-cusped molars, three sharp-pointed premolars, a slender canine, and three incisors placed at some little distance from each other.

These teeth thus seem to indicate an insectivorous marsupial resembling the still surviving genus *Myrmecobius* and the fossil *Spalacotherium* of Purbeck.

We thus see that without doubt it is the insectivorous type of dentition that is most clearly developed in the oldest mammalian teeth. We may well lay special stress on this point, which seems to us to be of peculiar

importance, for with regard to the form of the crown with several sharp peaks, and the distinction between the different sorts of teeth, molars, premolars, canines, and incisors, the insectivorous is not inferior in richness to any other. The dentition in all the other orders of mammals appears rather to be a modification or degradation of some kind or other of the original insectivorous dentition, and at the most we can point to the more complex internal structure of certain dentitions as instances of a higher development. The considerable number of the teeth would rather appear to connect these primitive dentitions of the old marsupials with those of the reptiles. If we assume that the *Dromatherium* had the same number of teeth in both jaws, then the total number of teeth belonging to it would amount to fifty-six, and even this number is exceeded by that found in the *Thylacotherium* (*Amphitherium*) of the Jurassic period, in which the like assumption would give a total of sixty-four teeth.

The Stonesfield Slates, belonging to the Lower Oolitic strata of the Jurassic period, have yielded many highly interesting lower jaws, some of which (*Amphitherium*, *Amphilestes*, *Phascolotherium*) still show the insectivorous type of dentition along with the characteristic inflexed angle of the lower jaw of the marsupials, while the genus *Stereognathus* again presents a quite different character. The fragment of the latter that has been preserved has three molars with crowns which seem to indicate rather a herbivorous or an omnivorous animal. According to Owen these teeth differ considerably from those of all other living or extinct mammals known to us. The form most closely resembling them is found in the second lower molar of *Pliolophus vulpiceps*, a small hoofed animal of the London Clay (Lower Eocene), which again is connected through the genus *Hyracotherium*, belonging to the same strata, with the *Palæotherida* of the Upper Eocene. Other naturalists profess to discover a certain resemblance between

the teeth of *Stereognathus* and those of the still living koala.

It is important to observe further that the hoofed mammals, at least as regards their dentition, are descended from an animal belonging to the Jurassic period whose marsupial character is not indeed perfectly demonstrated, but is nevertheless highly probable.

A wide gap separates the marsupials of the Stonesfield Slates from those of the "dirt-bed" of the Purbeck strata. Geologists still dispute, not indeed about the relative position, but about the classification of these strata; if they are referred to the Jurassic system then they form its uppermost story; if, on the other hand, they are referred to the Cretaceous system, then they form its base. But whichever of these two systems they be assigned to, the fact remains, that between those Purbeck strata and the lower members of the Tertiary series there lies the whole extent of the Cretaceous system, which has hitherto appeared to be altogether devoid of mammalian remains.

In the case of most of the jaws found in the Purbeck region the marsupial character is unequivocally demonstrated by the occurrence of the inflexed angle of the lower jaw; in the case of the others it appears to be placed beyond doubt by the great similarity of the teeth to those of actual marsupials of the present day. In general the insectivorous type still prevails: *Spalacotherium*, *Amblotherium*, *Peralestes*, *Stylodon*, *Balodon*, are characteristic insectivores; *Triconodon*, *Triacanthodon*, already present more resemblance to the carnivorous Tasmanian wolf, a living marsupial form, as the reader will remember. Only the genus *Plagiaulax* presents a quite exceptional type. While Owen refers it to the carnivorous mammals and ranks it with the genus *Thylacoleo* of the Quaternary strata of Australia, other investigators regard *Thylacoleo* and *Plagiaulax* as herbivorous and allied to the rat-kangaroos. In the strata of the Upper Jura of Wyoming in America,

corresponding to the Purbeck Beds of England, still other remains have been found, some of which (*Ctenacodon*) are allied to *Plagiaulax*, and others again (*Dryolestes*, *Tinodon*) appear, on the contrary, rather to be insectivorous in their relations.

At the end of the wide interval of the Cretaceous Period there at last appear in the Upper Eocene and Lower Miocene of Europe, besides *Plagiaulax*, the genus *Peratherium*, allied to the opossums, and the genus *Galethylax*, both of which may be regarded as sub-genera of the present *Didelphyida*. The smaller species of the latter still retain a perfect insectivorous dentition, while in the larger species the shortening of the inner cusps or peaks in the molars indicates a relationship to the carnivorous teeth provided with a heel such as is seen in the martens and *Viverrida*.

With respect to the dentition we should thus be able to establish the existence of an almost unbroken chain of insectivorous marsupials stretching down from the earliest period in which there are any mammalian remains whatever to the present day, though in doing so it would certainly be necessary to note the tendency to a bunodont dentition manifested in the genus *Stereognathus* of the Stonesfield Slates, and the tendency to a carnivorous dentition that appears still later in the remains found in the Purbeck strata. The dentition of *Plagiaulax* might even be regarded as representing a peculiar type, which would lead up either to the rodents or to elephants.

The different views that have been put forward regarding the transitional forms of dentition such as are represented by the genera *Stereognathus*, *Plagiaulax*, and *Thylacoleo*, show that these are indeterminate equivocal types, from which different forms of dentition with well-marked characters might be developed; that, in other words, they are collective types exhibiting a union of characters which afterwards come to be separated.

Another trait in the organization also deserves to be noted.

A large number of the present-day marsupials are hand-footed, that is, have the great toe of the hind-foot (the hallux) capable of being opposed to the other toes, whereby a true hand is formed, at least as regards function. The phalangers, the koala, and above all, the members of the opossum family are distinguished by such a structure of the hind-feet; in general, accordingly, those genera and families which have retained the insectivorous type of dentition. It must, of course, be admitted that it is very far from being the case that all insect-eaters exhibit this character; the genus *Myrmecobius* with its very pronounced insectivorous dentition has only four toes on the hind-feet, but except for the peculiar modification seen in the kangaroos, most marsupials have five free toes on the hind-feet, these toes being provided with curved nails or claws. There are, however, some genera in which the thumb or great toe carries a flat nail. On account of these characters the marsupials were formerly even placed among the *Ungiculata* (nailed mammals) beside the rodents or the edentates, and this error is still clung to by some naturalists, who concern themselves more with toes and nails than with all the other parts of the structure.

So far, I believe, no fossil remains have been found which could give any exact knowledge of the structure of the foot of the old marsupials; but from the close relationship existing between the genera *Peratherium* and *Galethylax* on the one hand, and the opossums on the other hand, we may probably conclude that these Eocene genera were likewise hand-footed, and the insectivorous character of still older genera leads to the presumption that they were at least clawed mammals if not likewise hand-footed.

In consideration of these facts we come therefore to the conclusion that five-toed feet, and indeed feet with free nailed toes, may, with the highest probability, be regarded as the primitive type of mammalian limbs, and that all other forms of limb have been developed out of this form. If this conclusion is correct, it follows further that five-toed feet constructed on this type indicate no advance, but are an inheritance from long-extinct ancestors. The very probable existence of hands in the Eocene opossums likewise proves to us that the hand is an original structure and not the last result of a continuous process of development leading to a higher and higher degree of perfection. The only thing that can be urged with any force against this supposition is the fact that in the marsupials the hand is restricted to the hind-limbs. But we meet with a similar phenomenon in the prosimians and monkeys, which are pre-eminently the climbers among the placental mammals, these having the hands of the hind-limbs much better developed than those of the fore-limbs.

Our examination of the limbs thus leads us to the same conclusions as the consideration of the dentition: the seemingly more highly developed forms are the original and inherited ones, the simpler forms, on the contrary, the result of a later adaptation.

We can thus sum up our investigations regarding the marsupials by the statement that they are the oldest known mammals, and that their present geographical distribution, in connection with that of the oldest representatives known to us, does not show their derivation from a single primitive type, but rather proves that they have sprung from many roots.

THE MONOTREMES

(MONOTREMATA).

Non-placental mammals without true teeth, with the genital and urinary ducts opening along with the rectum into a common chamber (*cloaca*). They have neither marsupial pouch nor teats, but have milk-glands and marsupial bones.



This order, consisting only of two Australian genera, the duck-mole and the echidnas, represents beyond doubt the lowest stage of degradation that can be reached by the mammalian type. The structure of these remarkable animals exhibits its many points of resemblance to the marsupials, but there are other characters peculiar to them which seem to have been derived from reptiles, amphibians, or fishes.

The smooth brain of these animals is even less developed than that of the marsupials, and has, like that of the latter, an imperfect corpus callosum and simple corpora quadrigemina with scarcely observable furrows. The eyes are small, and the external ears altogether wanting. The slit-like external openings of the ears can be opened and closed by the animal at pleasure. The bones of the skull become fused, as in the birds, very early. The teeth are either altogether wanting, or are represented, as in the duck-mole, only by horny plates. The lower jaw is very weak and has no inflexed angle. Through the development of coracoid bones the shoulder-girdle of the monotremes comes to resemble that of the above-mentioned lower vertebrates. The mouth has the form of a beak, in the duck-mole flat and blunt, in the echidnas rather long and pointed, and is not, as in

almost all other mammals, clothed with fleshy lips, but with a horny covering. The structure of the sexual organs is quite peculiar. The ovaries produce large eggs, but that of the right side is, as in the birds, degraded. There is no true uterus. The egg remains a long time in an enlargement of the oviducts, which open separately along with the urinary ducts into a common canal, the urino-genital canal, which in its lower part receives also the rectum, and thus forms a cloaca with a single opening to the exterior. Such a structure, which exists also in the amphibians, reptiles, and birds, is found also in the embryos of the other mammals, in which, however, it disappears in the course of development.

The monotremes have five toes on all four limbs. On the ankle of the hind-foot (the tarsus) there is a sharp, horny spur supported by a few tiny bones, and this spur might be regarded as a sixth toe. In the females this spur is only rudimentary. In the males it is traversed by a canal leading into a gland lying beneath the skin of the foot. The true function of this spur, which has been erroneously regarded as a venomous weapon, is not yet known.

Quite recently it has been definitely shown, especially by Haast and Caldwell, that the

monotremes lay eggs similar to those of reptiles and birds. These eggs have a thin but yet calcareous shell and are carried about for a time in a depression of the skin. Into this depression open several canals belonging to glands which secrete milk and which accordingly are true milk-glands, but which form no projecting teats. In the duck-mole the egg-pouch forms a longish fold of the skin,

which, after the escape of the young one from the egg, becomes so reduced as to be scarcely recognizable, and is seized hold of by the young one with its broad beak in sucking. The young of the echidna, on the other hand, is lodged in a round brood-pouch, in which it buries its head with its still short beak, seizing hold of the bottom of the pouch along with the gland openings which are



Fig. 264.—The Water-mole or Duck-mole (*Ornithorhynchus paradoxus*).

found there. Here, accordingly, we see a transition to the formation of a complete marsupial pouch.

Concerning the development of the young in the egg we possess so far no observations. In any case they escape from the egg while still in a very imperfect state of development. The youngest specimens which have been found were still without hair, the eyes were closed and concealed by the skin; on the short limbs the five toes are, however, already recognizable, and in the males also the spur. The beak of these young ones is very short, in the duck-mole roundish, in the echidnas more elongated. The large thick tongue reaches to the point of the beak and apparently plays in sucking the part of a piston.

The two genera forming this order are so different in their bodily structure that they

must be regarded as representatives of different families.

The Water-Mole, Duck-mole, or Duck-billed Platypus.

This, the sole known species (*Ornithorhynchus paradoxus*), fig. 264, is a native of Southern Australia and Tasmania. It may attain a length of about 20 inches, and presents a very singular appearance. The body is rather long, compact, and almost everywhere of the same thickness. It rests on short massive legs, and carries a flat broad tail, which is only slightly covered with hair, and that only on the under side. The body, which resembles that of the sea-otter, is covered with a short, thick, gray down interspersed with numerous coarse hairs of a brown colour, these hairs being pretty long on the back, where they almost form a sort

of spines. On the under parts they are finer and somewhat silky, and the down hair in those parts is rather lighter in colour. The mixture of these two hues produces a varied play of colour. The legs are so short that the animal in walking or running actually drags its body along the ground. They have five toes with strong burrowing claws. A broad web unites the toes of the fore-feet, and projects so far beyond them that the nails appear to rest on the web itself, the free edge of which folds back when the animal burrows in the ground. The spur on the hind-feet of the males is large and curved backwards.

On the body thus adapted for an aquatic mammal there is set a head which might rather be compared with that of a duck than that of a mammal if it had not hair, or rather a soft down on its hinder part. Here are seated the very tiny eyes, on the upper surface of the skull but directed forwards, while a little further back may be observed the openings of the ears, which, as already mentioned, the creature has the power of closing at pleasure. Half the length of the head is occupied by the flat, horny, broad-ended beak, the form of which reminds us of that of certain ducks. It is separated from the hairy part of the head by a horny protuberance, capable of being laid back and expanded. The nostrils are placed at the end of the beak, which is surrounded by a horny but very sensitive lip. The lower jaw is much narrower than the upper, but has a form adapting it to fit into the latter. Far back in the mouth may be seen the thick horny and warty tongue; two of the warts resemble sharp-pointed teeth. In each half of the lower jaw, and on each side of the base of the skull, in a position corresponding to the more retired position of the lower jaw, there is a depression with a reticulated bottom, in which there is a warty eminence formed of horny fibres, so that, if this wart were actually a tooth, the animal would have four long, horny, flattened teeth at the back of the mouth.

The singular creature leads an aquatic life. It excavates for itself burrows of from 20 to 25 feet in length¹ on the banks of quiet streams and creeks where there is a muddy bottom. The entrance to these burrows lies under the water. Many side galleries are given off in the course of the main burrow, which ultimately leads to a chamber, sometimes found to contain the female with her unshapely young. The latter are proved by the contents of their stomachs actually to feed on milk. As a rule, the duck-mole leaves its burrow on the approach of night, yet it sometimes tumbles about in the water even by day. It swims and dives admirably, and gropes about in the mud with its beak. On the whole the duck-moles appear to be of a lively and peaceable disposition; the young ones especially appear to be fond of playing together, and their behaviour shows them to be possessed of a keen scent and acute hearing. They dive at the slightest sound. Specimens of these animals have been kept in captivity for a certain length of time, but since their habits were not known, they have ultimately either escaped, or been drowned, or have died of hunger.

[Dr. Bennett, a naturalist, who visited Australia in the earlier part of the present century, having procured two young specimens of the duck-mole, or mallangong, as it is called by the natives, by digging them out of a burrow 35 feet in length, was able to make some interesting observations on their behaviour. "The little animals appeared often to dream of swimming," he says; "for I have frequently seen their fore-paws in movement as if in the act. If I placed them on the ground during the day, they ran about seeking some dark corner for repose; and when put in a dark place, or in a box, they huddled themselves up as soon as they became a little reconciled to the locality, and went to sleep. . . . They usually reposed side by side, looking like a pair of furred balls, and surly little growls issued from them when disturbed; nevertheless, when very sound asleep, they might be handled and

¹ Bennett, author of the *Wanderings of a Naturalist in Australasia*, mentions that the burrows of the duck-mole are sometimes 50 feet in length.—Tr.

examined without evincing any signs of annoyance. One evening both the little pets came out about dusk, went as usual and ate food from a saucer, and then commenced playing like two puppies, attacking each other with their mandibles, raising their fore-paws, and tumbling one over the other. . . .

In the struggle one would get thrust down; and at the moment when the spectator would expect it to rise again and renew the combat, it would commence scratching itself, its antagonist looking on and waiting for

the sport to be renewed. When running they were exceedingly animated, their little eyes glistened, and the orifices of their ears contracted and dilated with rapidity. . . .

Their eyes being placed so high on the head, they do not see objects well in a straight line,

and consequently run against everything in the room during their perambulations, spreading confusion among all the light and easily overturnable articles. . . .

"At first I was inclined to consider them as nocturnal animals, but I afterwards found that their time of leaving their resting-place was exceedingly irregular, both during the day and night. They seemed, however, more lively and more disposed to ramble about the room after dark, generally commencing about dusk; but all their movements in this respect were so very capricious that no just conclusion could be drawn, further than that they were both night and day animals, preferring the cool and dusky evening to the heat and glare of noon. . . . I have often found one asleep and the other running about at the same period of the day, the male alone first leaving the nest, and the female remaining asleep: he would, after feeding and running about for a short time, return, curl himself up and sleep, and then the female would leave in her turn. Although, however, they thus frequently left

the nest alternately, at other times they would suddenly go out together. . . .

"It was very curious to see the uncouth little creatures open their mandible-like lips and yawn, stretching out the fore-paws and extending the webs of the fore-feet to their utmost expansion. Although this was natural, yet, not being in the habit of seeing a duck yawn, it had the semblance of being perfectly ridiculous. It often surprised me how they contrived to reach the summit of a book-case,

or any other elevated piece of furniture. This was at last discovered to be effected by the animal supporting its back against the wall, placing its feet against the book-case, and thus, by means of the strong cutaneous muscles of the back and the claws of the feet contriving to reach the top very ex-

peditiously. They often performed this mode of climbing, so that I had frequent opportunities of witnessing the manner in which it was done. The food I gave them was bread soaked in water, chopped egg, and meat minced very small. Although, at first I presented them with milk, they did not seem to prefer it to water."—Bennett, *Wanderings of a Naturalist in Australasia*.]

The Echidnas.

Of the genus *Echidna* several species are known. That shown in fig. 265, the Long-spined Echidna or Porcupine Ant-eater (*Echidna hystrix* (*aculeata*)), inhabits the mountains of South Australia, and is distinguished from the Short-spined Echidna (*E. setosa*) of Tasmania by the possession of black-pointed spines which taper uniformly to their extremities, while those of the latter species are thickened in the middle and have white



Fig. 265.—The Long-spined Echidna or Porcupine Ant-eater (*Echidna hystrix*).

points. Perhaps even these species are merely local varieties. In recent years, however, Gervais has described a third species belonging to New Guinea with a relatively longer beak which is curved downwards, and this species he has erected into a new genus, giving to it the name of *Acanthoglossus Bruynii*. From these discoveries it would appear that the family of the porcupine ant-eaters has a much wider geographical distribution than that of the duck-moles. In its external appearance the long-spined echidna resembles a large hedgehog with a long beak and a rudimentary tail. The head, with the exception of the beak, the neck, belly, and feet, are set with thick silky bristles which are in general short, but are specially well developed round the slits forming the external openings of the ears. The beak may be compared to that of a snipe. It is as long as the rest of the head and a little arched. In its front part are situated the nostrils, and its under side is grooved so as to allow free play for the long worm-like tongue, which is flattened and covered with a horny layer. The lower jaw is remarkably thin, and so surrounded by the horny envelope of the beak that only a very small opening remains for the mouth, an opening only just sufficient to allow of the protrusion of the tongue. Above the opening of the mouth is a narrow horny upper-lip. Of teeth there is not the slightest trace. The animal feeds chiefly on ants. These it procures by means of its tongue, which is always kept covered with a viscous secretion derived from the large salivary glands situated beside the throat.

The back and sides of the body are covered with short, solid, sharp-pointed spines, between which are set numerous bristles. The animal can roll itself up into a ball like our hedgehog, but prefers to burrow under the ground to escape from its enemies. The feet are essentially burrowing feet. In the whole class of the Mammalia there is perhaps no other species with so strong a shoulder-

girdle, a humerus so much flattened or provided with such prominent ridges for the attachment of the muscles. The fore-feet form a broad spade-like implement; the five toes are armed with very long flat claws; the hind-feet are narrower and longer, and in them the second toe is the strongest. The spur of the male attains a considerable size, and the marsupial bones are likewise well developed. The short tail is hidden under two bunches of spines.

The porcupine ant-eaters prefer the dry woods of mountainous regions up to a height of about 3000 feet or more, so long as they find plenty of ant-hills. They lead a nocturnal life, sleeping by day in holes. In attacking an ant-hill they first dig a hole in it and then insert their viscous tongue, to draw it out again covered with ants. Like the armadillos they dig their way under the ground with remarkable rapidity, and hold on with such firmness to a hole that they have once begun that it is only with the greatest difficulty that they can be torn away from it. They are indolent and in captivity generally gentle creatures. Young specimens have been brought to England and fed at first with milk, afterwards with hard-boiled eggs rubbed down. Their flesh is said to be pretty good. They are very tenacious of life. In the museum at Geneva there is a skeleton of a porcupine ant-eater showing the marks of a blow with a sharp instrument which divided eight ribs in a line parallel to the line of the back. This enormous wound afterwards became perfectly healed, for one can see that the broken ribs are re-united by means of new bone substance.

GEOGRAPHICAL DISTRIBUTION AND ORIGIN OF THE MONOTREMES.

The geographical distribution of the members of this group is remarkably simple. They are essentially an Australian type.

The duck-mole is entirely confined to Australia and Tasmania; the porcupine ant-eaters, on the other hand, as recent discoveries have shown, extend to New Guinea.

In contrast to this the origin of these creatures is very obscure. The palæontological data bearing on the question are limited to a few remains of an echidna which have been found in the Quaternary strata of Australia. This poverty of fossil remains combined with the low organization of the creatures has called forth the most singular speculations, to which we must devote a few words.

First of all we cannot fail to be struck by the insufficiency of the dental system. The echidna, like the manis, has no teeth at all, and it is noteworthy that it approaches the latter animal also in the structure of the jaws, tongue, and nails, besides resembling it in the nature of its food. The duck-mole possesses a few horny plates which in respect of their structure may perhaps be compared with the teeth of certain fishes. This reduction of the dentition must certainly be pronounced an acquired character due to a long process of modification, for all old mammals possess a very complete dentition and also in general more teeth than their descendants.

Now the skeleton exhibits the closest affinity not only to that of reptiles and birds but also to that of amphibians, in addition to which it has certain marsupial characters.

We cannot here enter into the details of these relationships, the exposition of which would lead us beyond the scope of this work. It is enough to mention the fact that all investigators are agreed upon these points, and recognize the characters which these creatures possess in common with the lower vertebrates on the one hand, and the marsupials on the other hand.

What conclusion shall we draw then from this singular commingling of characters? May we from the facts just mentioned deduce the inference which has recently been put forward and forced into publicity by some natu-

ralists of mark, that the monotremes are an older form than the marsupials, and that the latter are direct descendants of the former?

There are two facts which stand in opposition to this view: first, the rudimentary dentition; and second, the present geographical distribution of the monotremes.

With respect to the first point the difficulty has sometimes been got over by a wholly groundless assertion. According to those who get over the difficulty in this way "the now extinct monotremes, which comprised all the forms of the then existing mammalian fauna, had certainly a more highly developed dentition, which had been transmitted to them by the fishes," and *Microlestes* and *Dromatherium* of the Jurassic Period "are probably descended from these primitive mammals." This hypothesis is in fact altogether without foundation. Wherever we have discovered the inner side of the lower jaw of those primitive mammals, there we have been able to observe the characteristic inflexed angle of the marsupials, nothing of which is seen in the monotremes. Yet that is of no consequence! The descendants may have acquired or lost this character, may also have gained or lost any number of teeth.

Further, the present geographical distribution does not give the slightest indication of any great antiquity belonging to this type. Wherever we meet with old groups, which have reproduced themselves with ceaseless modifications through the geological epochs, while retaining their general characters, like the *Insectivora*, *Ungulata*, and so forth, we find them spread over wide areas, taking possession of almost entire continents; and when we have to do with old types, which are near their point of extinction, we find the few survivors in the most widely different geographical regions. The tapirs afford a striking example of geographical discontinuity of this kind in types which are undoubtedly very old, but which are gradually disappearing. We must, therefore, look with con-

vidence for monotremes on one or other hemisphere, if these actually represent a very ancient group reduced at the present day to a small number of descendants. But instead of that we find the members of the group restricted to a remarkably narrow area, an area that could hardly be smaller—the east and south of Australia, Tasmania, and New Guinea; and nowhere else has the slightest trace of them been discovered either in the fauna of the present day or in the deposits of past geological epochs. Such a limited distribution belongs rather to types which have had only a very brief past.

In the present state of our knowledge we can accordingly assert nothing positive concerning the origin of this abnormal and highly aberrant type. We can only say that the facts, which must in any case be admitted to

be very indeterminate, speak rather in favour of a somewhat recent origination of this group by degeneration from the marsupials. But it is possible to defend all kinds of surmises and hypotheses; and while some regard the monotremes as direct descendants of the fishes or reptiles, in favour of which view, it must be admitted, the laying of eggs by monotremes gives considerable weight; while others again hold them to be degraded marsupials, which have degenerated through an adaptation to a lower stage of development, we must modestly confess that comparative anatomy cannot decide in whose favour the balance inclines. This science is, however, so far, the only one that would have a word to say on the subject, for neither the palæontology nor the embryology of these animals is known.

GLOSSARY.¹

ABDOMEN (Lat.). The posterior cavity of the body, separated from the chest by the diaphragm, and containing the intestines, liver, kidneys, and other viscera.

ABOMASUM (Lat. *ab*, from, and *omasum*, bullock's tripe). The fourth or true digestive stomach in the compound stomach of the ruminants. Also called *Rennet Stomach*. See fig. 37.

ACCESSORY HOOFS. See **HOOFS**.

ACETABULUM (Lat., a cup-shaped vessel). The socket in which the upper end of the thigh-bone is inserted. In the Echidna or spiny ant-eater this socket is not ossified in the middle, so that the part of the pelvis where it is situated appears perforated in the dry skeleton, as in birds, &c.

ALLANTOIS (Gr. *allas*, *allantos*, a sausage). A pear-shaped sac developed from the posterior end of the primitive alimentary canal in the young of mammals and some other vertebrates before birth. In the higher mammals it elongates, and while the terminal portion expands and enters into intimate connection with the wall of the uterus in the parent, and thus helps to form the placenta, the other portion forms part of the umbilical cord, containing the great blood-vessels by means of which the vascular system of the young is brought into communication with that of the parent. After birth the portion of the allantois within the body of the young remains through life as the urinary bladder.

ALLUVIAL. Belonging or pertaining to alluvium.

ALLUVIUM (Lat. *alluvio*, an inundation). A deposit of soil collected by the action of water; a term sometimes specifically applied in geology to the more recent of the Post-tertiary or Quaternary deposits, those in which the mammals are all of still living species. In this sense, in which it is distinguished from *Diluvium*, the word is more frequently used by continental than by English writers.

AMNION (Gr.). A membrane investing the young of mammals and some other vertebrates before birth.

AMPHIBIA (Gr. *amphi*, both, and *bios*, life). A class of vertebrates adapted in the young condition to live in the water and breathe by gills, but in a more advanced stage to live on land and breathe by lungs.

ANAL (Lat. *anus*, the posterior or inferior opening of the alimentary canal). Pertaining to, or situated in the neighbourhood of the anus; as, *anal* glands.

ANALOGOUS (Gr. *ana*, according to, and *logos*, ratio). A term applied in natural history to mean similar

in function though different in structure, as the wing of a bird and the wing of a bat. See **HOMOLOGOUS**.

ANASTOMOSE (Gr. *ana*, again, anew, and *stoma*, a mouth). To inosculate with or run into each other; to communicate with each other, as the arteries and veins.

ANCESTOR (Old Fr. *ancestre*, from Lat. *antecessor*, a predecessor). In the language of the evolutionary theory a form from which a later form is believed to have developed by natural descent.

ANCESTRAL. Pertaining to an ancestor; having the character or characters of an ancestor in the evolutionary sense of that term.

ANKYLOSED, or **ANCHYLOSED** (Gr. *angkylos*, crooked, *angkylē*, a joint). A term applied to bones immovably fixed together in places where joints have at one time existed or usually do exist.

ANTHROPOID (Gr. *anthrōpos*, man, *eidos*, form). Resembling man.

ANTHROPOMORPHÆ (Gr. *anthrōpos*, a man, and *morphē*, form). The name of the group of apes which has most resemblance to man; the group including the gorilla and chimpanzee, the orang-utang, and the gibbons.

ANTHROPOMORPHOID. Belonging to or resembling the Anthropomorphæ.

ANTLERS. The branching horns of a stag. See fig. 1.

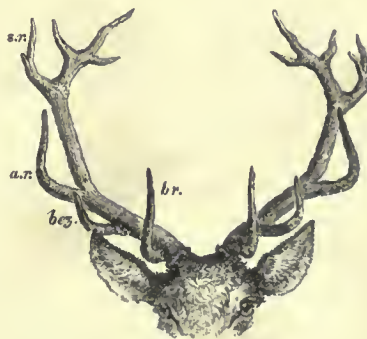


Fig. 1.—Antlers of Red Deer. *br.* Brow-tine; *bez.* Bez-tine; *a.r.* Antler-royal; *s.r.* Sur-royal.

APOPHYSIS (Gr. *apo*, from, and *physis*, growth). A protuberance growing out from a bone; a knob or prominent part of a bone, whatever shape it may happen to possess.

ARBOREAL (Lat. *arbor*, a tree). Living on or frequenting trees.

ARCHAIC (Gr. *archē*, beginning). Primitive; as applied to structures in an evolutionary sense, belonging to a primitive type.

¹The author is indebted to Prof. W. A. Herdman of University College, Liverpool, for kindly reading the proofs of this Glossary.

ARTIODACTYLA (Gr. *artios*, even, and *daktylos*, a finger). The name of an order of hoofed animals in which the number of toes is even (two or four), and there are two main axes in the lower part of the leg. See the body of the book, vol. ii. pp. 38-9 and 61, and under **CANNON-BONE** in this Glossary. See also fig. 2.



Fig. 2.—Skull of Sheep, a typical Artiodactyle, belonging to the group of the Ruminants. Showing the close-set cheek-teeth adapted for grinding, the wide interval between them and the front teeth of the lower jaw, the incisor-shaped canine placed in a line with the latter, and the absence of front-teeth in the upper jaw.

ARTIODACTYLE. One of the Artiodactyla.

ARYTENOID (Gr. *arytaina*, a ladle or cup). A term applied in anatomy to two small cartilages at the top of the larynx, and also to the muscles, glands, &c., connected with these cartilages.

ASTRAGALUS (Gr. the ankle-bone). The bone of the ankle supporting the inner of the two bones of the lower leg, namely, the tibia or shin-bone. See fig. 7.

ATLAS (in Gr. mythology the god who was believed



Fig. 3.—Atlas Vertebra, seen from above, *ri*. Ring-shaped opening in the centrum or body of the vertebra to receive the odontoid process *o.p.* of axis vertebra (Fig. 4).



Fig. 4.—Side view of Axis Vertebra. *o.p.* Odontoid process.

to support the earth on his shoulders). The first vertebra of the neck, articulating with and supporting the skull. In the mammals it is ring-shaped, and in the higher forms its centrum or body is replaced by a process from the second vertebra or *axis* fitting into the ring. See figs. 3 and 4.

AXIS. The name of the second vertebra. See **ATLAS**.

BALEEN (Lat. *balæna*, a whale). The horny plates on the palate of the true or whale-bone whales. See fig. 5.

BEAM. In a special sense, the main stem of a deer's antler above the burr.

BICORNUATE (Lat. *bis*, twice, and *cornu*, a horn). Two-horned; specifically applied to a uterus which forks and terminates in two cavities.

BRAIN, LARGE, and SMALL or HIND. See respectively **CEREBRUM** and **CEREBELLUM**.

BRECCIA (Ital.). In geology, an aggregate composed wholly or mainly of angular fragments of the same rock or different rocks united by a matrix or cement.

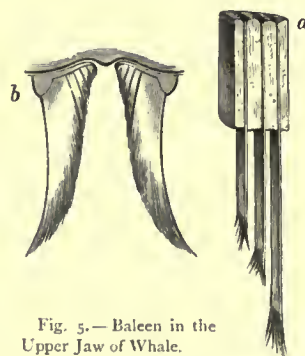


Fig. 5.—Baleen in the Upper Jaw of Whale.

a. Section of a portion of the palate of a whalebone whale showing three baleen plates. *b.* The arrangement of the baleen plates on opposite sides of the jaw.

BUNODONT (Gr. *bounos*, a mound, and *odontos*, a tooth). Having tubercled teeth; specifically applied to a group of the Artiodactyla. See fig. 6.

BURR. A ring-shaped bony ridge at the base of a deer's antler, a little above the skull.

CÆCUM (Lat. *cæcus*, blind). A blind process or more or less elongated sac in the alimentary canal of various animals.

CALCANEUM (Lat., the heel). The largest bone of the ankle, very prominent in the horse. See figs. 7, 34.

CAMPANULATE (Lat. *campanula*, a bell). Bell-shaped; specifically applied to a certain form of placenta.

CANINE (Lat. *canis*, a dog). The eye-tooth, the tooth coming immediately after the incisors; very prominent in the Carnivora, and hence named from one of the most familiar members of this order. See figs. 6 and 9.

CANNON-BONE (Gr. *kanōn*, a ruler). The single bone extending from the toes to the ankle-bones in ruminants and some other quadrupeds. In the horse it is from the first a single bone and is without any longitudinal groove; in the cow or

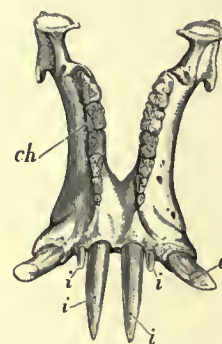


Fig. 6.—Lower Jaw of Hippopotamus. *ch.* The Cheek-teeth, originally tubercled, but worn down by use so as to present the appearance of clover-leaves bordered by bands of enamel; *i.* Incisors; *c.* Canines. See the body of the book, vol. ii. pp. 62 and 65.

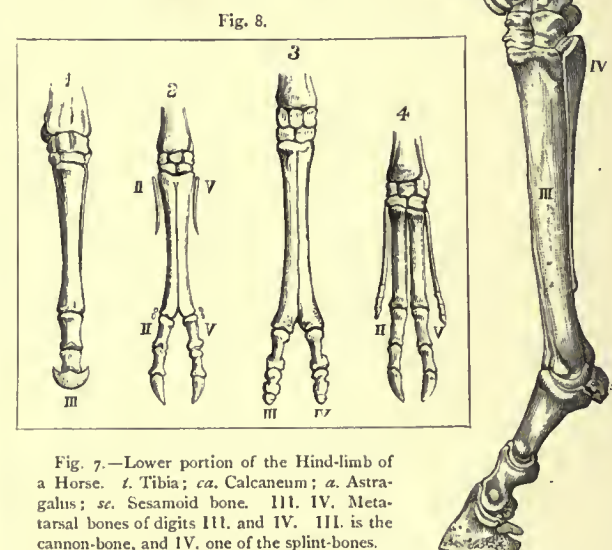


Fig. 7.—Lower portion of the Hind-limb of a Horse. *i.* Tibia; *ca.* Calcaneum; *a.* Astragalus; *se.* Sesamoid bone. III, IV. Metatarsal bones of digits III. and IV. III. is the cannon-bone, and IV. one of the splint-bones.

Fig. 8.—1. The Cannon-bone of a Horse, formed of a single metacarpal bone carrying the third digit. The digits are numbered in the cut according to the usual practice. See *Digit*.

2. Cannon-bone of a Sheep, formed of the fused metacarpal bones carrying the third and fourth digits. II, V., Splint-bones representing the second and fifth metacarpals. II, V., Nodules representing the second and fifth digits. On the outside these are indicated by the false or accessory hoofs.

3. Cannon-bone of a Camel, formed in the same way as that of the sheep. Observe the complete fusion in the middle and distinct separation at the lower extremity.

4. Lower part of Fore-limb of Tragulus, showing the metacarpals of the functional digits either not fused at all or only very partially so, and the two complete but small and functionless lateral digits.

sheep it is formed by the fusion or union of two bones, and the place of fusion is indicated by a longitudinal

groove down the middle; in the camel, these two bones are separate at the lower end; and in the Tragulina they remain separate throughout life or fuse only at a late period. See figs. 7 and 8.

CARAPACE (Fr.). A protective shield, like that of the armadillos, or the hard covering of certain insects, or crustaceans, &c.

CARDIAC (Gr. *kardia*, the heart). Pertaining to the heart, nearer the heart; applied to the part of the stomach situated nearest to the entrance of the œsophagus.

CARNASSIAL (Lat. *caro*, *carnis*, flesh). The name applied to a tooth found in the Carnivora, and adapted for tearing flesh. It has lateral cusps or prominences

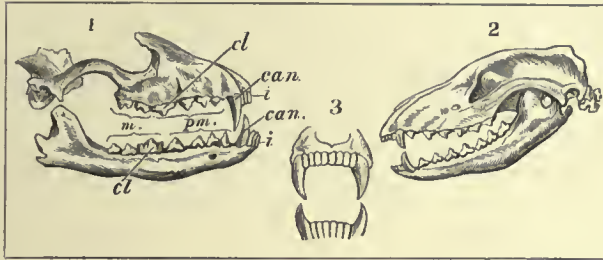


Fig. 9.—1. Skull of Dog. *m.* Molars; *pm.* Premolars; *cl.* Carnassial; *can.* Canines; *i.* Incisors. 2. Skull of Thylacinus. Note in fig. 3 (representing the front-teeth of Thylacinus) the four incisors in the upper, and three in the lower jaw.

for dividing the flesh, and a tubercled internal heel or process. It is either a molar or premolar. Also called *Sectorial*. See the description of the carnivorous dentition in the general account of the Carnivora in the body of the book. See fig. 9.

CARNIVORA (Lat. *caro*, *carnis*, flesh, and *voro*, to devour). An order of mammals mostly adapted for a flesh diet. See fig. 9.

CARNIVORE. A member of the Carnivora.

CARPAL. Pertaining to the carpus.

CARPUS (Lat.). The wrist or the part of a limb corresponding to the wrist, as, for example, the so-called "knee" in the fore-limb of a horse.

CARTILAGE (Lat. *cartilago*). The name of a tough elastic tissue in the body; gristle.

CARTILAGINOUS. Composed of cartilage.

CATARRHINE (Gr. *kata*, down, and *rhis*, *rhinos*, the nose).

Adj. belonging to the Catarrhinæ, or the group of Quadrumana, which includes the ape, gorilla, chimpanzee, &c., and in which the openings of the nostrils are directed downwards. *Noun*, a member of the Catarrhinæ.

CAT-TRIBE. Used in the text as equivalent to Felida, or the family comprising the genus *Felis* and allied genera. See fig. 10.

CEMENT. The bony tissue enveloping the fang of a tooth, and sometimes found filling up spaces between enamel ridges on the crown.

CENTRUM. See VERTEBRA.

VOL. II.

CEREBELLUM (Lat.). The small or hind brain. See figs. 11–13.

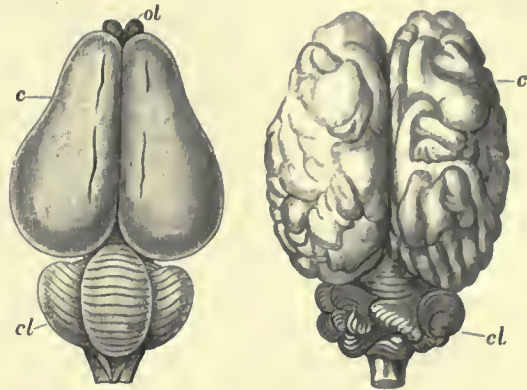


Fig. 11.—Brain of Agouti.

Fig. 12.—Brain of Horse.



Fig. 13.—Brain of Baboon—vertical section. *ol.* Olfactory lobes; *c.* Cerebrum, large brain or brain proper; *cl.* Cerebellum, small or hind brain; *cc.* Corpus callosum.

CEREBRAL. Pertaining to the cerebrum.—*Cerebral hemispheres*, the two halves of the large brain.

CEREBRUM (Lat.). The fore- or large brain. See figs. 11–13.

CERVICAL (Lat. *cervix*, the neck). Pertaining to the neck.

CETACEA (Gr. *kētos*, a whale). An order of mammals comprising the whales, dolphins, and their allies. See figs. 20 and 21.

CHEEK-TOOTH. One of the teeth behind the canines, whether a molar or a premolar.

CHEVRON BONES (from the name of a zigzag ornament in heraldry). A name given to V-shaped bones placed between the bodies or centra of adjacent vertebræ on the under side of the tail. See figs. 14 and 27.

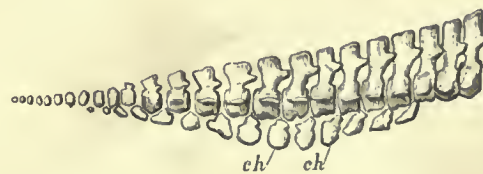


Fig. 14.—Skeleton of the Tail of a Dolphin. *ch.* Chevron bones.

CHIROPTERA (Gr. *cheir*, the hand, and *pteron*, a wing). The order of mammals comprising the bats. See fig. 15.

CLAVICLE (Lat. *clavicula*, a little key). The collar-bone, the bone extending from the shoulder-blade to the breast-bone.

CLOACA (Lat., a sewer). A common chamber or cavity into which the alimentary canal and the ducts of the generative and urinary organs open, as in the monotremes.

COCCYX (Gr. *kokkyx*, a cuckoo). The terminal portion of the vertebral column in man, so called from its resemblance to a cuckoo's beak. See fig. 32.

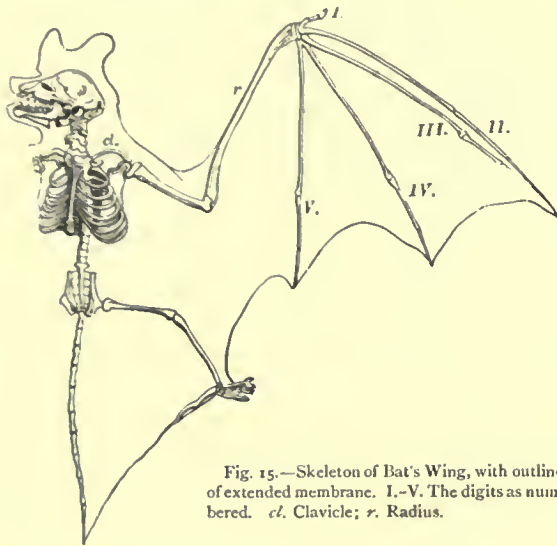


Fig. 15.—Skeleton of Bat's Wing, with outline of extended membrane. I.-V. The digits as numbered. cl. Clavicle; r. Radius.

COLON (Gr.). The middle section of the large intestine, forming the largest portion of the whole intestine.

CONDYLE (Gr. *kondylos*, a knuckle). A rounded knob at the end of a bone serving to form a joint with another bone.

CORACOID (Gr. *korax*, a crow, and *eidos*, form). A bone present in the monotremes (as well as in birds and some other vertebrates) passing from the shoulder-joint to the breast-bone; so called because it corresponds to a process of the shoulder-blade in man resembling a crow's beak. See fig. 16.

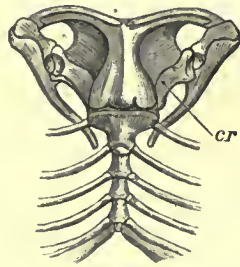


Fig. 16.—Part of the Skeleton of the Duck-mole. cr. Coracoid.

CORONOID (Gr. *korōnē*, a crow, and *eidos*, form). A term applied to the upper anterior process near the hinder end of the lower jaw; so called on account of its curved shape resembling a crow's beak. See figs. 33, 36, and 39.

CORPORA QUADRIGEMINA (Lat., fourfold bodies). A portion of the brain lying between the cerebrum and the cerebellum.

CORPUS CALLOSUM (Lat., hard or callous body). In anatomy, the great band of brain tissue which unites the two hemispheres of the cerebrum in mammals. See fig. 13.

CRANIAL REGION. See under **SKULL**.

CRANIUM (Lat.). The part of the skull inclosing the brain.

CRUMEN GLANDS. Scent-glands in the deer family, situated in depressions in the lachrymal bone in the neighbourhood of the eye.

CRUPPER. The rump or buttocks of a horse.

CUSP (of a tooth). One of the prominences of the molar or check-teeth.

DECIDUATE (Lat. *decido*, to fall off). A term applied

to a placenta, the whole of which, including the part formed from the wall of the uterus of the mother, is cast off at the birth of the young animal.

DECIDUOUS (Lat. *decido*, to fall off). Liable to be shed; as the milk-teeth.—*Deciduous Placenta*: same as *Deciduate Placenta*.

DEGRADED. In evolutionary language, applied to a structure which is believed to have lost certain special characters possessed by ancestral types. The *degraded carnassial* of the bears, for example, is a tooth which does not possess the marked characters found in the carnassial teeth of most Carnivora.

DENTITION (Lat. *dens*, a tooth). 1. The arrangement and structure of the teeth. 2. A set of teeth of a particular character.—*Complete dentition*, a set of teeth in which all the three kinds, *incisors*, *canines*, and *check-teeth* (molars and premolars) are represented. See fig. 9.

DEVELOPMENT. A term used in botany and zoology in a special sense to signify the organic changes which take place in animal and vegetable bodies from their embryo state to the state of maturity.

DIASTEMA (Gr., an interval). Specifically, a gap or interval between teeth.

DIFFERENTIATE. To render different; specifically, in evolutionary language, to become differentiated is to be made different from a previous type through the acquisition of special characters.

DIFFERENTIATION. 1. The process of differentiating. 2. A character or set of characters by which one form is distinguished from another of more primitive type.

DIFFUSE. As applied to the placenta, having tufts or lobes containing blood-vessels distributed all over the surface of the embryo.

DIGIT (Lat. *digitus*, a finger). A general term used by naturalists to denote either fingers or toes in man or the members corresponding to these in the lower animals. The digits are always numbered from the innermost outwards, supposing the palm of the hand or sole of the foot to be laid down flat. Thus the thumb or great-toe is always the first digit; and when certain digits are wanting, as in the horse or cow, the absent digits are always taken into account in naming those which are present. See figs. 17, 20-23, 27, 34, and 35.

DIGITIGRADE (Lat. *digitus*, a finger, and *gradior*, to step or walk). Applied to animals which in walking touch the ground only with the digits or toes, and not with the parts corresponding to the

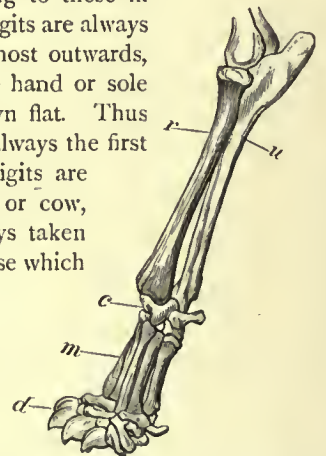


Fig. 17.—Lower part of the Fore-limb of a Lion, to illustrate the digitigrade structure. r. Radius; u. Ulna; c. Carpal bones; m. Metacarpal bones; d. Digits.

sole of the foot or palm of the hand in man; in a more special sense, applied to a group of the Carnivora distinguished by that mode of standing and walking. See fig. 17.

DILUVIUM (Lat., a deluge). Specifically, in geology, the earlier deposits of Post-tertiary or Quaternary times,

those deposits in which many of the mammals belong to species now extinct; in this country usually called Pleistocene or Post-pliocene. See ALLUVIUM.



Fig. 18.—Skull of Great Ant-eater. *na.*, Nasal; *ma.*, Maxilla; *p.m.*, Pre-maxilla. Observe the entire absence of teeth, and the incomplete zygomatic arch (*z.a.*).

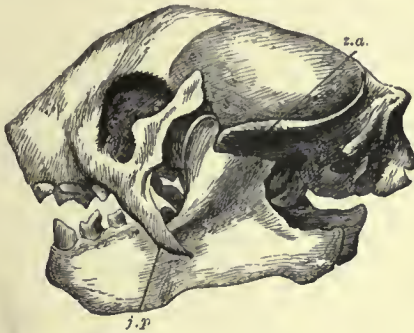


Fig. 19.—Skull of Sloth. *j.p.*, Jugal or malar process; a downward process from the jugal or cheek bone. *z.a.*, Incomplete zygomatic arch.

DIPHYODONT (Gr. *dis*, twice, *phyō*, to become, and *odous*, *odontos*, a tooth). Furnished with two sets of teeth in succession, as man.

DISCOIDAL (Gr. *diskos*, a disc, and *eidos*, form). Having the form of a disc; more or less round and flat.

DISTAL (Lat. *disto*, to stand apart or away from). Farthest away from the trunk or centre; as, the wrist-bones are at the *distal* ends of the radius and ulna.

DIURNAL (Lat. *diurnus*, belonging to the day). Active by day, not by night.

DORSAL (Lat. *dorsum*, the back). Pertaining to the back.—*Dorsal region*, the back part of the body from the neck to the last of the false ribs.

EDENTATA (Lat. *e*, without, *dens*, a tooth). An order of mammals in which the middle incisors are always wanting, and in some members of which there are no teeth at all. See figs. 18 and 19.

EDENTATE. A member of the Edentata.

EMBRYO (Gr. *en*, in, and *bryō*, to swell). A young animal before birth.

EMBRYOLOGY (*embryo*, and Gr. *logos*, discourse). The science which deals with the development of embryos.

EMBRYONIC. Pertaining to an embryo.

EOCENE (Gr. *ēos*, dawn, and *kainos*, new). Belonging to the oldest division of the Tertiary rocks. See GEOLOGICAL TABLE, vol. i. p. 23.

EPIGLOTTIS (Gr. *epi*, upon, and *glōtta*, the tongue). A cartilaginous plate behind the tongue, which during the act of swallowing covers the glottis or slit-like opening into the larynx at the top of the windpipe, and thus prevents foreign bodies from entering the latter.

EPITHELIUM (Gr. *epi*, upon, and *thēlē*, the nipple). A thin and delicate kind of cuticle like that which covers the nipple; specifically, a tissue composed of one or more layers of cells covering any free surface of the body, including the walls of internal cavities, such as the mouth, and such passages as have an internal free surface, like the nasal passages, respiratory organs, &c. The epidermis or scarf-skin is only a slightly modified epithelium.

EURASIAN. Belonging to the combined continent of Europe and Asia.

EVOLUTION. The process by which one species is believed to be developed by natural descent from pre-existing species.

EVOLUTIONARY. Pertaining to evolution, or pertaining to the theory that new species arise by natural descent from pre-existing ones.

FACIAL REGION. See under SKULL.

FAUNA (Lat., the goddess of fields, cattle, &c.). A collective name for the animals belonging to a region or epoch; as, the *fauna* of Great Britain; the Triassic *fauna*.

FELINE (Lat. *felis*, a cat). Used in the text in the sense of a member of the genus *Felis*, or (as an adjective) belonging to the genus *Felis*.

FEMUR (Lat.). The thigh-bone; the bone of the upper part of the hind-leg.

FETLOCK. A tuft of hair growing behind the pastern joint of horses, and also the joint itself.

FIBULA (Lat., a brooch). The outer of the two bones of the lower hind-leg, corresponding to the *ulna* of the fore-leg or fore-arm. See figs. 20–23.

FLIPPER. The fore-limb modified so as to serve for a paddle in swimming, as in seals, whales, and sea-cows.

FLORA (Lat., the goddess of flowers). A collective name for the plants belonging to a region or epoch. See FAUNA.

FORM. Used in botany and zoology as a general term for a species or variety.

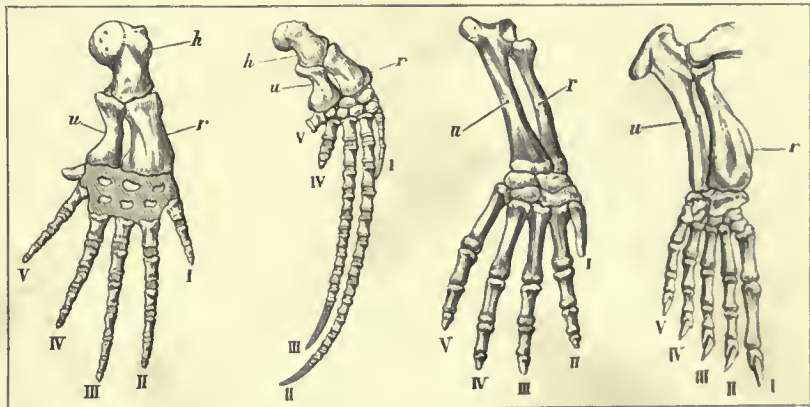


Fig. 20.—Skeleton of the Fore-limb or Flipper of the Whalebone Whale.

Fig. 21.—Same of the Casing Whale.

Fig. 22.—Same of the Dugong.

Fig. 23.—Same of the Seal.

r, Radius; *u*, Ulna; *h*, Humerus. I.–V. Digits.

FOSSA (Lat., a ditch). A depression.—*Temporal fossa*, the depression in the skull in the region of the temple. See fig. 24.

FRŒNUM LINGUÆ (Lat., bridle of the tongue). The ligament or fold of the mucous membrane which is

situated underneath the tongue, and limits the motions of that member.

FRONTAL (Lat. *frons*, *frontis*, the forehead). One of the bones of the forehead in man, or one of the corresponding bones in one of the lower animals. See fig. 39.

FUNCTIONAL. Acting; performing a function.

FUNCTIONLESS. Having no function; as the splint-bones in the leg of a horse.

FUSED. Specifically applied to bones united though originally distinct; that is, either distinct in the embryo, in the young animal, or in some allied form.

GLAND (Lat. *glans*, *glandis*, an acorn). A part of an organism yielding some special secretion.

GLOTTIS (Gr.). The slit-like opening into the trachea or windpipe.

HALLUX (Lat. *hallex*, or *allex*, the thumb or great-toe). The first digit of the hind-foot. See DIGIT.

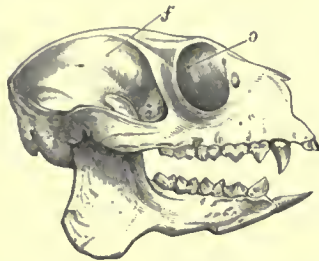


Fig. 24.—Skull of Black Indris. *f*. Temporal fossa; *o*. Orbit. In this case the orbit is open behind and thus communicates with the temporal fossa.

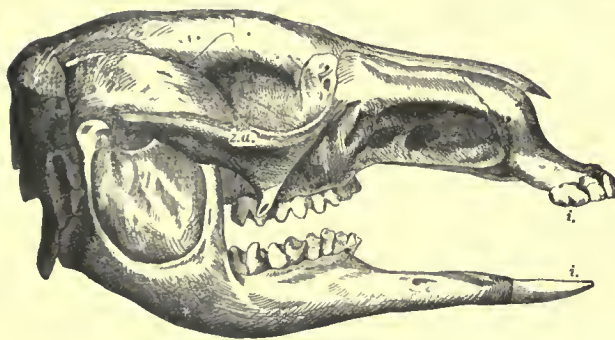


Fig. 25.—Skull of Kangaroo. Observe the horizontal incisor of the lower jaw. *i*. Incisors. *z.a.* Zygomatic arch.

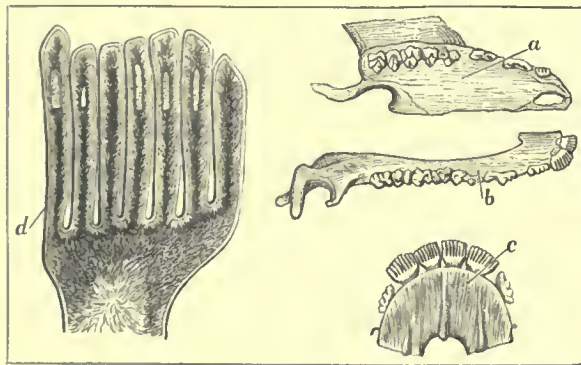


Fig. 26.—*a*. Upper, *b*. Lower Jaw of the Colugo or Flying-cat (*Galeopithecus volans*); *c*. Front portion of the lower jaw, showing the pectinate incisors; *d*. Section of one of the pectinate incisors (magnified).

HEEL (of a tooth). A portion of the tooth extending horizontally from the base.

HOLOTHURIAN. A member of the sea-cucumber order of echinoderms, or the class which includes the sea-urchins.

HOMOLOGOUS (Gr. *homos*, same, and *logos*, ratio or proportion). Corresponding in structure though not

in function, as the arm of a man and the wing of a bat.

HONEY-COMB BAG. Same as *Reticulum*.

HOOFS. Horny coverings encasing the toes all round.—*Accessory hoofs*, the small hoofs present in sheep, goats, and other members of the cow family at some distance above the ground, representing the absent second and fifth digits. See DIGIT.

HUMERUS (Lat.). The bone of the upper arm or corresponding bone in the lower animals.

HYOID (Gr. *Υ*, and *oidos*, form). The Y-shaped bone at the root of the tongue, which it serves to support in vertebrates.

INCISOR (Lat. *incido*, to cut into). One of the teeth situated in the premaxillæ (in the front of the mouth) in the upper jaw, or the corresponding teeth in the lower jaw; so called because generally adapted for cutting or dividing. Their form is exceptional in rodents, hippopotamuses, many marsupials, the flying cat (*Galeopithecus*), and some other animals. See figs. 2, 6, 9, 25, 26, and 36.

INDECIDUATE (Lat. *in*, not, and *decido*, to fall off). Applied to a placenta which is not wholly extruded from the body of the parent at the time of the birth of the young animal. See DECIDUATE.

INDEX (Lat., a pointer). The fore-finger, or second digit of the extremity of the fore-foot.

INGUINAL (Lat. *inguen*, the groin). Pertaining to or situated in the region of the groin.

INSECTIVORA (Lat. *insectum*, an insect, and *voro*, to devour). An order of mammals mostly adapted for feeding on insects. See fig. 35.

INSECTIVORE. A member of the Insectivora.

INSECTIVOROUS. Pertaining to the Insectivora; insect-eating.—*Insectivorous dentition*, a dentition of a simple kind, in which the teeth are exceptionally uniform in character, generally more or less conical in shape.

INTERDIGITAL (Lat. *inter*, between, and *digitus*, a finger). Situated between the fingers or digits.—*Inter-digital glands*, glands situated on the hoof-bearing joints of many ruminants. See body of the book, vol. ii. p. 73.

INTERMAXILLARY (Lat. *inter*, between, and *maxilla*, the bone at the side of the upper jaw). Same as premaxilla; so called because the two premaxillæ are contiguous and lie in the middle of the mouth between the two maxillæ.

ISCHIAL CALLOSITIES. Naked warty patches on the hips of many monkeys.

ISCHIUM (Lat.). The lowermost or hindmost part of the hip-bone, a separate bone in the embryo.

JUGAL BONE. The cheek-bone; the bone external to the eye and giving prominence to the cheek. In a group of the sloths this bone is characterized by a well-marked descending process. See fig. 19.

KAINOZOIC (Gr. *kainos*, new, and *zōē*, life). In geology, same as Tertiary. See GEOLOGICAL TABLE, vol. i. p. 23.

LACHRYMAL (Lat. *lachryma*, a tear). Pertaining to tears, or to the place where tears are formed.—*Lachrymal bone*, one of the bones which compose the lower part of the orbit.—*Lachrymal sinus*, a depression in the

lachrymal bone in the deer family; the depression containing the crumen gland.

LAMBDOIDAL SUTURE (Gr. *lambda*, the letter Λ , and *eidos*, form). The suture at the back of the crown of the head connecting the upper part of the occiput with the two parietal bones. See **SUTURE** and fig. 39.

—**Lambdoidal crest**, a bony ridge situated at this suture.

LAMELLA (Lat.). A thin plate.

LARYNX (Gr. and Lat.). The voice-box; the upper part of the windpipe, the part in which sounds are produced.

LIBER (Lat., a book). The third compartment in the complex stomach of a rumi-

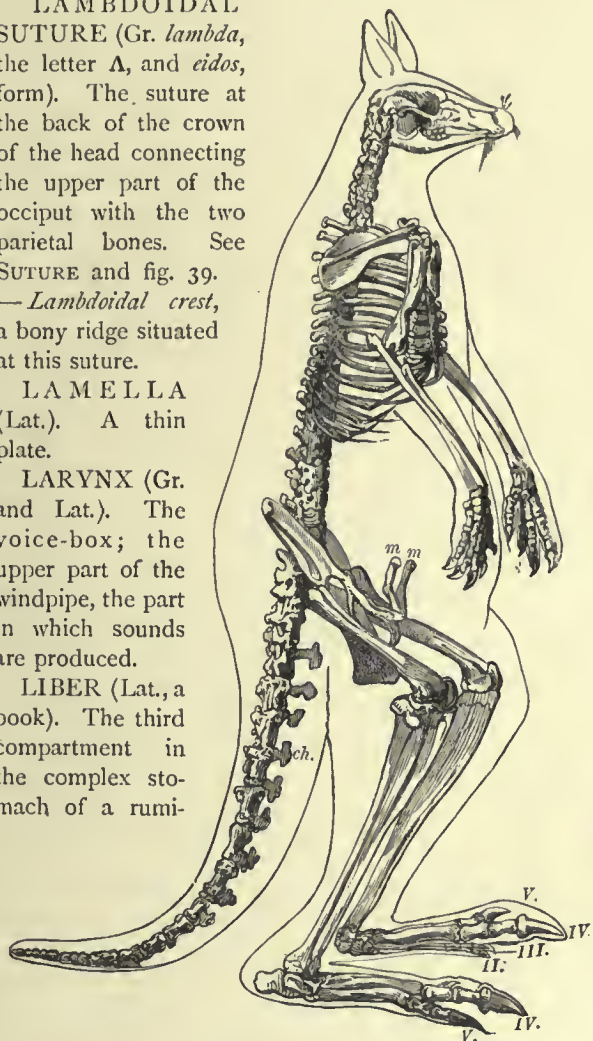


Fig. 27.—Skeleton of Kangaroo. *m.m.* Marsupial bones; II.—V. Digits as numbered. Observe the small second and third digits, which in the living animal are united under the same fold of skin as far as the claws. Observe also the strong tail with chevron bones (*ch.*).

nant; so called because it contains layers of mucous membrane arranged like the leaves of a book; also called *Omasum*, *Psalterium*, and *Manyplies*, or (Scotch) *Monyples*. See fig. 37.

LIGAMENT (Lat. *ligamentum*, from *ligo*, to bind). A strong tissue serving to bind one bone to another.

LUMBAR (Lat. *lumbus*, the loin). Pertaining to the loin.—**Lumbar region**, the posterior portion of the body between the false ribs and the upper edge of the haunch-bone.

MAMMÆ (Lat.). The female breasts. See vol. i. p. 3.

MANUBRIUM STERNI (Lat., handle of the breast-bone). Same as *Presternum*.

MANYPLIES = many folds. Same as **LIBER**.

MARSUPIAL. *Noun*, a member of the Marsupialia. *Adj.* pertaining or belonging to the Marsupialia.—**Marsupial bones**, two spur-like bones running forwards and

upwards from the front of the pelvis; characteristic of the marsupials and monotremes. See figs. 27 and 28.

MARSUPIALIA (Lat. *marsupium*, a pouch). An order of mammals in which the females usually have a pouch in front in which they carry about their young for some time after birth. See figs. 27 and 28.

MAXILLA (Lat.). One of the bones forming the side of the upper jaw; the bone in which all the teeth behind the upper canines are set.

MEDIAN (Lat. *medius*, middle). Placed in the middle; running along the middle line.

MESOZOIC (Gr. *mesos*, middle, and *zōē*, life). In geology, same as *Secondary*.

METACARPAL (Gr. *meta*, after, and *carpus*). Belonging to the palm of the hand, or the corresponding part in the fore-limb of the lower animals. See fig. 17.

METATARSAL (Gr. *meta*, after, and *tarsus*). Belonging to the sole of the foot, or the corresponding part in the hind-limb of the lower animals. See fig. 34.

MILK DENTITION, MILK TEETH. The teeth which first appear, and which are afterwards shed in those animals which have two sets of teeth.

MIOCENE (Gr. *meios*, less, and *kainos*, new). In geology, belonging to the middle division of the Tertiary rocks. See **GEOLOGICAL TABLE**, vol. i. p. 23.

MOLAR (Lat. *molo*, to grind). Sometimes used as a general term for one of the cheek-teeth, but more



Fig. 29.—Last Lower Tooth (Molar) of Indian Elephant.



Fig. 30.—Last Lower Tooth (Molar) of African Elephant.

specifically applied to those cheek-teeth which appear only in the permanent dentition. See figs. 6, 29, and 30.

MOLLUSK (Lat. *molluscus*, soft). A member of the Mollusca, the group of soft-bodied animals to which the snails, mussels, sea-slugs, &c. belong.

MONOPHYDONT (Gr. *monos*, alone, *phyō*, to become, and *odontos*, a tooth). Furnished with only one set of teeth in the course of life, like most of the Edentata. Distinguished from *Diphyodont*.

MONOTREMATA (Gr. *monos*, single, and *trema*, an aperture). The name of an order of mammals in which there is only one opening to the exterior for the chamber which receives the terminations of the intestinal canal, and the ducts of the urinary and generative organs.

MONOTREME. A member of the Monotremata.

NARES (Lat.). The nostrils.—**Posterior nares**, the passages leading from the nostrils to the back of the mouth.

NASAL (Lat. *nasus*, the nose). Belonging to the nose; specifically, applied to the bones inclosing the nostrils and situated immediately in front of the frontals. See figs. 31, 33, and 39.

NICTITATING MEMBRANE (Lat. *nicto*, to wink). A membrane placed within the eyelids, and capable of being rapidly passed over the front of the eye to remove foreign matters; also called the *third eyelid*. It is present in reptiles and birds, and in the monotremes among mammals.



Fig. 28.—Lower Jaw of Wombat, showing the inflexion behind, characteristic of the Marsupials.

NOCTURNAL (Lat. *nocturnus*, belonging to the night). Active by night, and resting by day; opposed to *Diurnal*.

NUCHAL (Low Lat. *nucha*, the nape of the neck). Pertaining to the nape of the neck.

OCCIPITAL. Pertaining to the occiput or back part of the head.—*Occipital bone*, the bone at the back of the head. See fig. 39.

OCCIPUT (Lat.). The back part of the head.

ESOPHAGUS (Gr. *oisophagos*). The gullet; the tube leading from the mouth to the stomach.

OLFAC-TORY (Lat. *olfacio*, *olfac-tum*, to smell). Pertaining to the sense of smell.—*Olfactory lobes*, two lobes or segments of the brain in which the nerves of smell have their origin. See fig. 11.



Fig. 31.—Skull of Rhinoceros. Observe the prominent nasal (*na.*) to support the horn or horns. *z.a.* Zygomatic arch.

OMASUM (Lat., bullock's tripe). Same as **LIBER**.

ONTOGENETIC (Gr. *onta*, beings, and *genesis*, generation). Pertaining to the development of the individual: distinguished from *Phylogenetic*. See **DEVELOPMENT**.

OPPOSABLE. As applied to the first digit of the fore- or hind-foot, capable of having the fleshy part on the fore or under surface placed in contact with the corresponding part of the other digits of the same extremity.

ORBIT (Lat. *orbita*, a circuit). The bony ring or socket in which the eye is set. It is said to be *closed* when cup-shaped as in man; *complete* when consisting of an entire ring though open behind, as in the lemurs; and *incomplete* when there is not an entire ring of bone, as in the Carnivora. See fig. 24.

ORBITAL. Pertaining to the orbit.

ORIGINAL. In evolutionary language, first in the course of development; also, present in or pertaining to a primitive type.

OSTEOLOGICAL (Gr. *osteon*, a bone, and *logos*, discourse). Pertaining to osteology or the science which treats of the bones; pertaining to the bones of the body and their arrangement.

OVARY (Lat. *ovarium*). The organ in the female producing ova or eggs.

OVIDUCT (Lat. *ovum*, an egg, and *ductus*, a duct). A passage for the ovum or egg from the ovary.

OVUM, plur. **OVA** (Lat.). An egg; a cell capable when impregnated of developing into a young animal.

PACHYDERM (Gr. *pachys*, thick, and *derma*, skin). A thick-skinned animal; a member of the Pachydermata, an order of mammals constituted by Cuvier to include the elephant, rhinoceros, hippopotamus, &c., the members of which are now divided among several orders.

PALÆONTOLOGY (Gr. *palaïos*, old, *onta*, beings, and *logos*, discourse). The science that treats of fossils or relics of extinct forms of life.

PALÆOZOIC (Gr. *palaïos*, old, and *zōē*, life). In geology, same as *Primary*.

PARIETAL (Lat. *paries*, a wall). Belonging to the side.—*Parietal bones*, the bones forming most of the side of the skull in man, and the corresponding bones in the lower animals. See fig. 39.

PATAGIUM (Lat., the border of a dress). The term applied to the flying membrane in bats, flying squirrels, the flying cat, and other quadrupeds capable of flying, or, at least, maintaining themselves in the air so as to make great leaps.

PAUNCH. The first compartment in the complete stomach of the ruminants. Also called *Rumen*. See fig. 37.

PECTINATE (Lat. *pecten*, a comb). Comb-like. See fig. 26.

PECTORAL (Lat. *pectus*, the chest). Pertaining to the chest.—*Pectoral arch*, same as *Shoulder-girdle*.

PELVIS (Lat., a basin). The bony arch connecting the lower or hind limbs, which are articulated to it. See fig. 32.

PERISSODACTYLA (Gr. *perissos*, odd, and *daktylos*, a finger). The name of an order of hoofed mammals in which there is always an odd number of toes on the hind-feet, and the toes on the fore-feet, if even in number, are unsymmetrical. See figure 33.

PERISSODACTYLE. A member of the Perissodactyla. See fig. 33.

PETROUS PORTION OF TEMPORAL BONE. See under **TEMPORAL**.

PHALANX, plur. **PHALANGES** (Gr., a row). One of the small bones of a finger or toe.

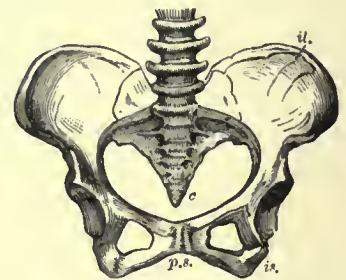


Fig. 32.—The Pelvic Bones and lower part of Vertebral Column in Man. *il.* Ilium; *is.* Ischium; *p.s.* Pubic symphysis; *c.* Coccyx.

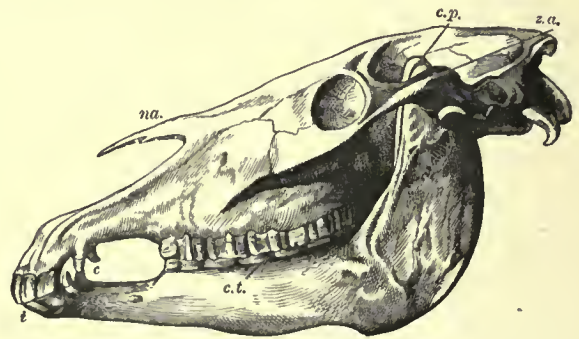


Fig. 33.—Skull of Horse, a typical Perissodactyle, showing dentition. *i.* Incisors; *c.* Canines; *c.t.* Check-teeth (molars and premolars similar); *c.p.* Coronoid process; *z.a.* Zygomatic arch; *na.* Nasal.

PHYLOGENETIC (Gr. *phylē*, a class or tribe, and *genesis*, generation). Pertaining to the evolution of a form or group of forms; pertaining to development from ancestral types.

PINNIPEDIA (Lat. *pinna*, a wing or fin, and *pes*, *pedis*, the foot). An order of mammals including the seals and walruses; sometimes considered as a sub-order of Carnivora. See **FLIPPER** and fig. 23.

PLACENTA (Lat., a cake). The organ by which in the higher mammals the blood vascular system of the embryo is brought into intimate connection with that of the mother.

PLANTIGRADE (Lat. *planta*, the sole of the foot, and *gradior*, to step or walk). Applied to animals which in standing and walking touch the ground with the entire sole of the foot, as man, or with the parts corresponding to the sole of the foot or palm of the hand. See fig. 34.

PLATYRRHINE (Gr. *platys*, broad, and *rhis*, *rhinos*, the nose). *Adj.*, belonging to the Platyrrhinæ, or the group of the Quadrumana in which the nose has a broad middle partition and the nostrils directed more or less sideways. *Noun*, a member of the Platyrrhinæ.

PLIOCENE (Gr. *pleios*, more, and *kainos*, new). In geology, the term applied to the most recent division of the Tertiary rocks. See GEOLOGICAL TABLE, vol. i. p. 23.

PLOUGHSHARE BONE. The name of a highly modified sesamoid bone present in the moles. See fig. 35.

POLLEX (Lat., the thumb). The thumb; the first digit of the hand or fore-foot. See DIGIT.

PREMAXILLA (Lat. *præ*, before, and *maxilla*). The bone situated in front of the maxilla; the bone in which the upper incisors are set. Also called *Intermaxillary* or *Intermaxillary Bone*.

PREMOLAR (Lat. *præ*, before, and *molar*). One of the front cheek-teeth; more precisely, one of the cheek-teeth which appear in the milk dentition and are replaced by others in the permanent dentition.

PRESTERNUM (Lat. *præ*, before, and *sternum*, the breast-bone). The anterior portion of the breast-bone; the *manubrium sterni*.

PRIMARY. In geology, the term applied to the older rocks from the Cambrian to the Permian inclusive. Also called *Palæozoic*. See GEOLOGICAL TABLE, vol. i. p. 23.

PROBOSCIDEA (Gr. *proboskis*, Lat. *proboscis*, and Gr. *eidos*, form). An order of mammals, the members of which are furnished with a proboscis which serves as an instrument for grasping and as an organ of touch; the elephant order.

PROBOSCIDEAN. A member of the Proboscidea.

PROCESS. Specifically, in comparative anatomy, an outgrowth, especially one of considerable length relative to its breadth; a prolongation, not a mere swelling, knob, or excrescence.

PRONATION (Lat. *pronus*, having the face downwards). The act of rotating the lower arm in such a

manner as to turn the palm of the hand downwards: opposed to *Supination*.

PROXIMAL (Lat. *proximus*, next). A term applied to the part of anything nearest to the trunk or point of origin; as the bone of the upper arm is articulated at its *proximal* end to the shoulder-blade: opposite to *Distal*.

PSALTERIUM (Lat. form of Gr. *psalterion*, the name of a stringed instrument). Same as *Liber*.

PYLORIC (Gr. *pyloros*, a gate-keeper). A term applied to that part of the stomach where the *pylorus* or opening into the intestine is situated: opposite to *Cardiac*.

QUADRUMANA (Lat. *quatuor*, four, and *manus*, the hand). The order of mammals comprising the apes and monkeys: so called because very generally provided with an opposable first digit both on the fore- and hind-feet.

QUATERNARY (Lat. *quatuor*, four). In geology, a term applied to all the rocks after the Pliocene. Also called *Post-tertiary*. See GEOLOGICAL TABLE, vol. i. p. 23.

RADIUS (Lat., a ray or spoke of a wheel). The bone of the forearm which lies innermost when the palm of the hand is laid flat, and the corresponding bone in the fore-limb of a quadruped. It corresponds to the *tibia* in the leg or hind-limb of a quadruped. See figs. 17 and 34.

RECTUM (Lat. *rectus*, straight). The terminal portion of the intestinal canal.

RENNET STOMACH. The abomasum, the fourth or true digestive stomach in the complex stomach of ruminants: so called from containing the juice which enables it to coagulate milk. See fig. 37.

RETE MIRABILE, plur. *RETIA MIRABILIA* (Lat., a wonderful net). A branching net-work of small blood-vessels in the course of a large blood-vessel.

RETICULUM (Lat., a net). The second division of the complex stomach of ruminants: so called from being divided into small compartments or cells by means of partitions crossing each other netwise. Also called *Honey-comb Bag*. See fig. 37.

RETRACTILE. Capable of being retracted.

RETROGRADE DEVELOPMENT. In evolutionary language, a modification or process of modification by which has been brought about a structure less highly specialized than one believed to have existed in an ancestral form.



Fig. 36.—Skull of Hare. Observe the small upper incisors *i* behind the large functional ones *i*; *c.p.* Coronoid process; *z.a.* Zygomatic arch.

RODENT (Lat. *rodo*, to gnaw, *rodens*, *rodentis*, gnawing). A member of the Rodentia.

RODENTIA. An order of mammals with incisor teeth specially adapted for gnawing. See fig. 36.

RUMEN (Lat., the throat). The paunch. See fig. 37.

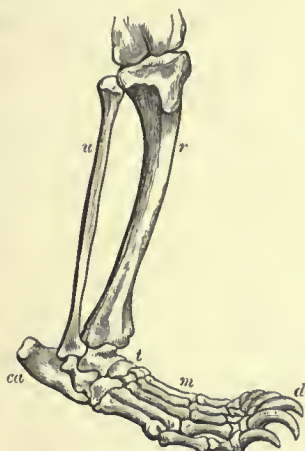


Fig. 34.—Skeleton of Hind-limb of Bear, to illustrate the Plantigrade structure. *r.* Radius; *u.* Ulna; *t.* Tarsal bones; *m.* Metatarsal bones; *d.* Digits; *ca.* Calcaneum.

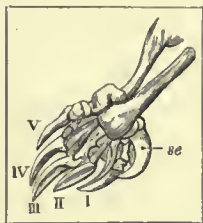


Fig. 35.—Lower part of the Fore-limb of a Mole. *se.* Sesamoid (ploughshare) bone. *I.*—*V.* Digits.

RUMINANT (Lat. *ruminor*, to chew the cud). An animal that chews the cud. See fig. 37.

SACRUM (Lat., sacred). The vertebrae (usually ankylosed) to which the haunch-bones are articulated.

SAGITTAL (Lat. *sagitta*, an arrow). A term applied to the suture connecting the two parietal bones. See under **SKULL**—*Sagittal crest*, a bony ridge in the position of the sagittal suture.

SCAPHOID (Gr. *skaphe*, a boat, and *idos*, form). The bone in the wrist at the end of the radius; the corresponding bone in the carpus of the lower animals.

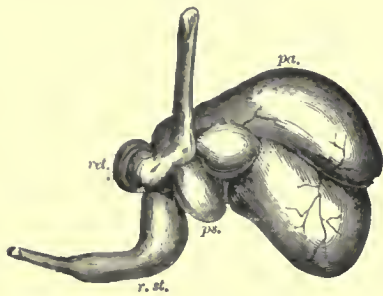
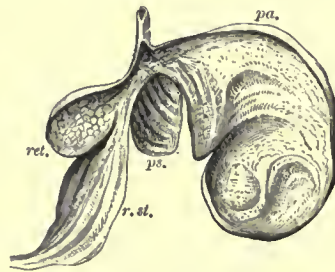


Fig. 37.—Stomach of Ruminant (external).

pa. Paunch or rumen; ps. Psalterium, liber, omasum, or manyplies; ret. Reticulum or honey-comb bag. r. st. Rennet-stomach or abomasum; the true digestive stomach.



Internal Structure of Stomach of Ruminant.

SCAPULA (Lat.). The shoulder-blade.

SEA-COW. The popular name for one of the Sirenia.

SEBACEOUS (Lat. *sebaceus*). Fatty; secreting fat.—*Sebaceous glands*, skin glands secreting an oily or fatty matter.

SECTORIAL (Lat. *seco*, to cut, *sector*, a cutter). Same as *Carnassial*.

SELENODONT (Gr. *selēnē*, the moon, and *odontos*, a tooth.) A term applied to teeth the surface of which exhibits crescent-shaped bands of enamel. See fig. 38.

SEPTUM (Lat.). A partition.

SESAMOID BONES. The name of certain bones formed at the joints of the toes and elsewhere in many mammals; so called from the supposed resemblance of many of them to the seeds of the Indian plant called Sesame. See figs. 7 and 35.

SHIN-BONE. Same as *Tibia*.

SHOULDER-GIRDLE. The circle of bones formed by the two shoulder-blades and the two collar-bones. Also called *Pectoral Arch*.

SINUS (Lat., a bay). A cavity.—*Frontal sinuses*, the cavities between the plates of the frontal bones or bones of the forehead, the cavities which in man produce the prominent ridges above the eyes.

SIRENIA (Gr. *seirēn*, a mermaid). An order of mammals. See fig. 22.

SKULL. The skeleton of the head. It is divided into a *cranial region*, constituting the brain-case, and a *facial region*, comprising the bones of the face. See fig. 39.

SNAG. A prong or spike; specifically applied to the single spike which is the earliest form of a deer's antler.

SPECIALIZE. To make special; to adapt to the performance of special functions. The teeth, for example, are said to be specialized when they are so formed as to

be adapted for performing the special acts of gnawing, as in rodents, grinding, as in horses and cows, and so on.

SPECULUM (Lat., a mirror). In zoology, a bright spot in animals, such as the light-coloured patch on the hind-quarters of the roe-deer.

SPHINCTER (Gr. *sphingktēr*, from *sphingō*, to constrain). A name applied generally to a kind of circular muscles, or muscles in rings, which serve to close the external orifices of organs, and more particularly to those among them which have the peculiarity of being in a state of permanent contraction, independently of the will, and of relaxing only when it is required that the contents of the organs which they close should be evacuated.

SPLINT-BONES. The functionless bones on each side of the cannon-bone of a horse, representing the metacarpal bones of the second and fourth digits. See fig. 7.

SUPINATION (Lat. *supinus*, on the back). The act of rotating the lower arm in such a way as to turn the palm of the hand upwards: opposed to *Pronation*.

SUPRA-OCCIPITAL CREST. Same as *Lambdoidal Crest* or *Ridge*.

SUTURE (Lat. *sutura*, from *suo*, to sew). The line along which any two bones of the skull are dove-tailed into one another. See **LAMBDOIDAL** and **SAGITTAL**, and fig. 39.

SYMPHYSIS (Gr., a growing together). The union of bones by means of cartilage; the place where bones are so united.—*Pubic symphysis*, the union of the bones in the inferior and front portion of the pelvis.

TARSUS (Gr. *tarsos*, the flat of the foot). The assemblage of small bones belonging to the ankle, and the corresponding bones in the hind-limbs of the lower animals.—*Tarsal region*, the region of the tarsus.

TEAR-PIT. Same as *Lachrymal Sinus*. See **LACHRYMAL**.

TEMPORAL (Lat. *tempora*, the temple). Belonging to the temple.—*Temporal fossa*. See under **FOSSA**.—*Petrous portion of the temporal bone*, that part of the temporal bone which contains the internal organs of the ear; answering to the *pro-otic*, or bone in front of the ear in the lower vertebrates.

TENDINOUS. Pertaining to a tendon; composed of tissue like that of a tendon.

TENDON (Fr. from Latin *tendo*, to stretch). In anatomy, a cord composed of a bundle of fibres forming a tough tissue which serves as the means of attaching a muscle to a bone.

TERRESTRIAL. Belonging to the earth; frequenting or inhabiting the surface of the ground: opposed to *Aquatic* and *Arboreal*.

TERTIARY (Lat. *tertius*, third). In geology, the term applied to the more recent rocks above the Cretaceous and ending with the Pliocene. See **GEOLOGICAL TABLE**, vol. i. p. 23.

THIRD EYELID. See **NICTITATING MEMBRANE**.

THORACIC. Belonging to the thorax.

THORAX (Gr.). The chest; the part of the body extending from the neck to the last of the ribs.



Fig. 38.—Upper Surface of Molar of *Cervus megaceros*, to illustrate selenodont dentition.

TIBIA (Lat., a flute). The shin-bone; the inner of the two bones of the lower leg, or lower part of the hind-limb in quadrupeds. It corresponds to the *radius* in the arm or fore-limb. See fig. 7.

TINE. A spike or prong; specially applied to a spiked branch of the antlers of a deer.

TRAGUS (Gr. *tragos*, a goat). The cartilaginous valve-like flap which extends from the front backwards over the entrance to the ear-passage: so called probably from the fact of its being provided in some persons with a tuft of hairs like a goat's beard.

TROCHANTER (Gr. *trechō*, to turn). A knob or process at or near the upper end of the thigh-bone for the attachment of muscles concerned in rotating the limb.—*Third trochanter*, a lateral trochanter near the upper end of the thigh-bone characteristic of the Perissodactyla.



Fig. 39.—The Cranium. *na*, Nasal; *fr*, Frontal; *pa*, Parietal; *o*, Occipital; *t*, Temporal; *j*, Jugal, malar, or cheek bone; *c.p*, Coronoid process; *z.a*, Zygomatic arch; *s.s*, Line of sagittal suture; *l.s*, Lambdoidal suture.

TUBERCLED

TOOTH. A tooth the surface of which is provided with small blunt knobs or tubercles; especially, one of the molars in the Carnivora behind the carnassials.

ULNA (Lat., the elbow). The outer of the two bones of the forearm when the palm of the hand is laid flat, or the corresponding bone in the fore-limb of one of the lower animals. It answers to the *fibula* in the hind-limb. See figs. 17 and 34.

UNDIFFERENTIATED. Not characterized by a special structure; for example, the simple and uniform teeth of the dolphin.

UNGUICULATE (Lat. *unguis*, a nail). Furnished with nails or claws.

UNGULATE (Lat. *ungula*, a hoof). Furnished with hoofs.

UTERUS (Lat.). The womb.

VASCULAR (Lat. *vas*, a vessel). Connected with or belonging to the system of blood-vessels, or the circulatory system.

VELVET. In a special sense, the delicate hairy covering of a deer's antlers while growing.

VERTEBRA (Lat. *verto*, to turn). One of the bones of the column inclosing the spinal cord. See fig. 40.

VISCERA (Lat. pl. of *viscus*). The contents of the great cavities of the body, especially of the chest and abdomen. Thus the heart, liver, stomach, &c., are all viscera, and one of them separately is a *viscus*.

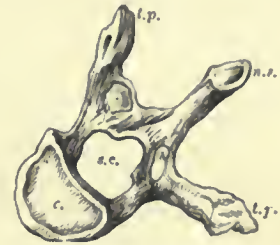


Fig. 40.—Dorsal Vertebra seen from above. *c*, Centrum or body of the vertebra; *s.c*, Spinal or neural canal; *n.s*, Neural spine, the whole series of which in the vertebral column forms the uneven ridge on the back; *t.p*, Transverse processes articulating with the ribs.

WITHERS. The elevation at the junction of the shoulder-bones of a horse.

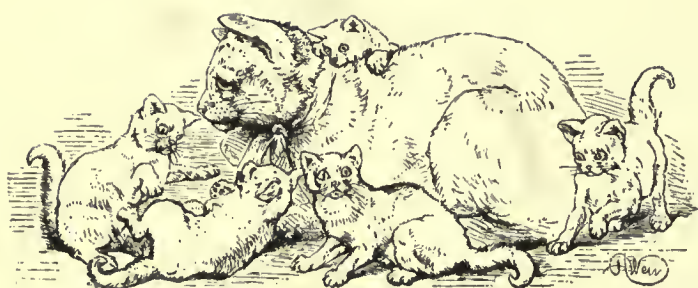
WRIST. The part of the arm where the hand is jointed to the forearm; sometimes

used in the body of the book in a wider sense to designate also the corresponding part in the fore-limb of one of the lower animals; the carpus.

ZONARY (Gr. *zōnē*, Lat. *zona*, a belt). Having the form of a belt or ring.

ZYGODONT (Gr. *zygon*, a yoke, and *odous*, *odontos*, a tooth). A term applied to teeth divided into transverse ridges by means of deep grooves, as in the tapir.

ZYGOMATIC ARCH (Gr. *zygōma*, from *zygon*, a yoke). The arch of bone in the skull formed by the meeting of a backward process from the jugal or cheek bone and a forward process from the temporal bone. In some forms this arch is incomplete. See figs. 31, 33, 36, and 39, and comp. figs. 18 and 19.



INDEX.

An asterisk * after number of page indicates an engraving; the contraction gen. chars. = general characters.

- Aard-vark, ii. 186, 187.*
Aardwolf, i. 157.* 234.
Abbu Addas, ii. 100.*
Acanthoglossus Bruynii, ii. 220.
Aceratherium, ii. 46, 59.
Achi, ii. 89.
Acrobates pygmaeus, ii. 204.
Addax nasomaculatus, ii. 100.* 101.
Agouta, i. 120.*
Agouti, Golden, ii. 169.*
—family, general chars., ii. 169.
Aguarachay, i. 145, 146.*
Aï, ii. 182.*
Ailuropoda, i. 188.
Ailuropus, i. 234.
—melanoleucus, i. 204.*
Ailurus fulgens, i. 203.*
Alactaga jaculus, ii. 160.* 162.
Alcelaphus Caama, ii. 101.*
Alces Machlis, ii. 86.*
—palmatus, ii. 86.*
Alluvium, ii. 223.
Alpaca, ii. 134, 135.*
Amblotherium, ii. 214.
Amphicyon, i. 236.
Amphilestes, ii. 213.
Amphitherium, ii. 213.
Amycodon, ii. 59.
Anchitherium, ii. 60.
Ancylotherium, ii. 190.
Aneturae, general characters, i. 66.
Angwantibo, i. 87, 88.*
Anoa, ii. 114.* 115.
—depressicornis, ii. 114.* 115.
Anoplotherium, ii. 62, 139.
Anta, ii. 42.* 43.
Ant-bear, ii. 187.*
—Cape, ii. 186, 187.*
Ant-eater, Banded, ii. 199.*
—Great, ii. 187.*
—Little, ii. 188.*
—Porcupine, ii. 219.*
Ant-eaters, Scaly, gen. chars., ii. 188.
—True, ii. 187.
Antelope, American Prong-horned, ii. 75.
—Four-horned, ii. 93.* 94.
—Harnessed, ii. 95.*
—Indian, ii. 102.*
—Mendes, ii. 100.*
—Pronghorn, ii. 87.* 88.
—Sable, ii. 98.*
—Sabre, ii. 99.*
Antelopes, general characters, ii. 88; 137, 139.
Anthropomorphæ, i. 32.
Antilocapra americana, ii. 75, 87.* 88.
Antilope cervicapra, ii. 102.*
Antilopida, general characters, ii. 88.
Aperæ, ii. 171, 172.*
Apes, Anthropoid, i. 32.
—Black Anthropoid, i. 32.
Apes, Red Anthropoid, i. 36.
— and Monkeys, gen. chars., i. 25.
— — Geographical Distribution and Descent of the, i. 73.
Aretictis binturong, i. 202.*
Arctocebus calabarensis, i. 87, 88.*
Arctocyon, i. 236.
Arctocyonida, i. 236.
Arctomys Bobac, ii. 147.
—marmota, ii. 147.*
—monax, ii. 147.
Arctonyx, i. 235.
Arctopithecii, i. 28, 30, 70.
Argali, ii. 112.
Armadillo, Giant, ii. 184.* 185.
—Six-banded, ii. 185.*
Armadillos, general chars., ii. 183.
Arni, ii. 110.*
Artiodactyla, general chars., ii. 61.
—Hollow-horned, ii. 74.
—Non-Ruminant or Many-toed, ii. 64.
— or Ruminants, Two-toed, ii. 73.
Arvicola, ii. 178.
—agrestis, ii. 157.*
—amphibius, ii. 158.*
—arvalis, ii. 157.*
Ashkok, ii. 41.*
Ass, ii. 55.
—African Wild, ii. 53.* 54.
—Tibetan Wild, ii. 54, 55.*
Asses, Wild, ii. 59.
Assapan, ii. 145.
Ateles, i. 30, 64.
—eriodes, i. 64, 65.*
Atherura africana, ii. 163.* 164.
Auchenia, general chars., ii. 134.
—Lama, ii. 134.* 135.
—Paco, ii. 135.*
—vicuña, ii. 136.
Auerochs, ii. 120, 126.
Axis maculata, ii. 80, 81.*
Aye-aye, i. 85.* 86.
Babakoto, i. 84.* 85.
Babirusa, ii. 71.* 136.
—alfurus, ii. 71.*
Baboon, Arabian, i. 51, 55.
—Common, i. 53, 57, 58.*
—Guinea, i. 57.
—Pig-faced, i. 57.
Baboons, general characters, i. 53.
Badger, Common, i. 213, 214.*
—Stinking, i. 215.* 216.
—family, i. 235.
—and Weasel family, general characters, i. 211.
Badgers, general characters, i. 213.
—American, general chars., i. 216.
—Honey, i. 217.
—Indian, general chars., i. 216.
—Pouched, general chars., ii. 197.
—True, i. 235.
Balæna australis, ii. 16.
—mysticetus, ii. 16.*
Balænoptera boops, ii. 15.* 16.
Balænoptera, ii. 16.
Balodon, ii. 214.
Bandicoot, Long-nosed, ii. 198.*
Banteng, ii. 125.* 126.
Banxings, general chars., i. 114.
Barbary Ape, i. 52.*
Barbastelle, i. 104.* 105.
Baribal, Black, i. 208.* 209.
Barrigudo, i. 64.*
Bassarist astuta, i. 198.*
Bat, Common Mouse coloured, i. 105.
—Dwarf, i. 106, 107.*
—Flap-nosed, i. 107, 108.*
—Greater Horse-shoe, i. 110.*
—Lesser Horse-shoe, i. 110.
—Long-eared, i. 97, 104.*
—Pug-nose, i. 104.* 105.
—Water, i. 105.*
Bats, general characters, i. 96.
—Fruit-eating, i. 101.
—Horse-shoe, i. 98; gen. chars., 109.
—Insect-eating, i. 103.
—Leaf-nosed, i. 107.
—True, i. 103.
—Water, i. 98.
—Geographical Distribution and Descent of the, i. 110.
Bear, Black, i. 208.* 209.
—Brown, i. 207.*
—Coco-nut Palm, i. 209.* 210.
—Common Indian Black, i. 210.*
—Gray or Grizzly, i. 206.
—Malayan, i. 209.* 210.
—Native (Australian), ii. 204, 205.*
—Pouched, ii. 204, 205.*
—Sloth-, i. 210.*
Bears, general characters, i. 196.
—Large, gen. chars., i. 204; 234.
—Small, gen. chars., i. 198; 234.
Beaver, ii. 149.*
—family, general chars., ii. 149.
Beech-marten, i. 222.*
Beef-eaters, African, ii. 29.
Behemoth, ii. 65.
Belideus sciureus, ii. 203, 204.*
Beluga, ii. 10.*
—leucas, ii. 10.*
Bibos frontalis, ii. 124.* 125.
Big-horn, ii. 111.*
Binturong, i. 202.* 234.
Bison, American, ii. 120.*
—European, ii. 119.*
—bonus, ii. 119.
Bisons, general characters, ii. 119.
Black Ape, i. 26, 53, 55.*
Blastoceros campestris, ii. 79, 80.*
Blauw-bok, ii. 99.
Bleekbok, ii. 91.* 93.
Boars, Wild, general chars., ii. 67.*
Bobac, ii. 147.
Bonnet-monkey, i. 49.
Bonto, ii. 4, 5.*
Boomer, ii. 208.
Boonder, i. 49, 51.
Bos, general characters, ii. 123.
—brachyurus, ii. 127.
—frontalis, ii. 124.* 125.
—frontosus, ii. 127.
—gaurus, ii. 124.*
—grunniens, ii. 123.*
—indicus, ii. 126, 127.*
—sondaicus, ii. 125, 126.*
—taurus, ii. 128.
Boselaphustragocamelus, ii. 96.* 97.
Bouquetins, general chars., ii. 108.
Bovida, general characters, ii. 115.
Brachyurus, general chars., i. 67.
—calvus, i. 67.*
—ouakari, i. 67.*
Bradypoda, general chars., ii. 181.
Bradypus tridactylus, ii. 182.*
Bramatherium, ii. 140.
Brocket, Red, ii. 79.*
Bruan, i. 209.* 210.
Bruta, ii. 180.
Bubalus, general chars., ii. 116.
—Caama, ii. 101.*
—caffer, ii. 116, 117.*
—Kerabau, ii. 119.*
—vulgaris, ii. 117.
Buffalo, Cape, ii. 116, 117.*
—Common, ii. 117.
Buffaloes, general chars., ii. 116.
Bunodontia, ii. 62.
Buphaga africana, ii. 29.
Burrowers (Insectivora), i. 122.
Burunduk, ii. 146.*
Buselaphus oreas, ii. 100.*
Bush-dog, i. 219.*
Caama, ii. 101.*
Cacamizli, i. 198.* 234.
Cachalot, ii. 13.*
Callithrix, Masked, i. 68.*
—personata, i. 68.*
Calotragus scoparius, ii. 91.* 93.
Camel family, gen. chars., ii. 129.
—Bactrian, ii. 131.*
Camelida, ii. 129.
Camelopardalis giraffa, ii. 128.*
Camels, ii. 130, 137, 140.
Camelus, ii. 130.
—bactrianus, ii. 131.*
—dromedarius, ii. 131.*
Campagnol, ii. 157.*
Canida, i. 234.
Canis, i. 136; general chars., i. 137.
—anthus, i. 141.*
—Azare, i. 145, 146.*
—corsac, i. 148.*
—dingo, i. 143.* 144.
—jubatus, i. 139.*
—lagopus, i. 149.*

- Canis latrans*, i. 140.*
 — *lupaster*, i. 139.*
 — *lupus*, i. 137.*
 — *mesomelas*, i. 145.*
 — *vulpes*, i. 146, 147.*
 — *zerda*, i. 150.*
Canna, ii. 100.*
 Cannon-bone, ii. 224.*
 Cape Daman, ii. 41.
 — *Ratel*, i. 216,* 217.
Capella rupicapra, ii. 89.*
Capra ægagrus, ii. 106.*
 — *angorensis*, ii. 107,* 108.
 — *falconeri*, ii. 105,* 106.
 — *ibex*, ii. 108,* 109.
 — *hircus*, ii. 107,* 108.
 — *megaceros*, ii. 105,* 106.
Capreolus caprea, ii. 79.*
 — *vulgaris*, ii. 79.*
Caprida, general characters, ii. 103.
Capybara, ii. 172, 173.*
Caracal, i. 182.*
Cariacou, ii. 83.
Cariacus campestris, ii. 79, 80.*
 — *rufus*, ii. 79.*
Carnivora, general chars., i. 129.
Carpophaga, i. 101.
Casoryx, ii. 140.
Castor, ii. 178.
 — *fiber*, ii. 149.*
Castorida, general chars., ii. 149.
Cat, *Coffee*, i. 191.*
 — *Gloved*, i. 171, 172.*
 — *Palm*, i. 191.*
 — *Pampas*, i. 179,* 180.
 — *Wild*, i. 172, 173.*
 — *tribe*, general chars., i. 158: ii. 225.
Catarrhinæ, i. 32.
Catoblepas, ii. 102.
 — *gnu*, ii. 103.*
Caudate, general characters, i. 42.
Cave-hyæna, i. 237.
Cavia aperea, ii. 171, 172.*
 — *cobaya*, ii. 171.
 — *porcellus*, ii. 171, 172.*
Cavicornia, general chars., ii. 87.
Cavy, *Patagonian*, ii. 171.*
 — *Restless*, ii. 171, 172.*
Cebidæ, general characters, i. 65.
Cebus, i. 65.
 — *capucinus*, i. 66.*
Centetes ecaudatus, i. 121.*
Centetida, i. 120.
Cephalophus mergens, ii. 92,* 94.
Cercolabes villosus, ii. 164.*
Cercoleptes caudivolvulus, i. 201,* 202.
Cercopithecii, i. 74.
Cercopithecus, i. 48.
 — *diana*, i. 49.*
 — *pyrrhonotus*, i. 49.
 — *sabæus*, i. 49.*
Cerebellum, ii. 225.*
Cerebrum, ii. 225.*
Cervida, general characters, ii. 77.
Cervulus muntjac, ii. 78.*
Cervus, general characters, ii. 82.
 — *Aristotelis*, ii. 80.
 — *axis*, ii. 80, 81.*
 — *elaphus*, ii. 82.*
 — *Sedgwickii*, ii. 139.
 — *virginianus*, ii. 83.
Chacma, i. 57.
Chæropus castanotus, ii. 198,* 199.
Chalicomys, ii. 178.
Chamois, ii. 89.*
Chectahs, i. 161, 162.
Chego, i. 35.
Cheironectes variegatus, ii. 194, 196.*
Chevrotain family, general characters, ii. 76; 136.
Chevrotain, *Water*, ii. 76.
Chikara, ii. 93,* 94.
Chimpanzee, i. 31, 33,* 74.
Chinchilla family, gen. chars., ii. 166.
 — *Larger*, ii. 166,* 167.
 — *Smaller*, ii. 167.*
 — *brevicaudata*, ii. 166,* 167.
 — *lanigera*, ii. 167.*
Chinchillida, general chars., ii. 166.
Chipmunk, ii. 146.*
Chirogaleus, i. 79, 81-83.
 — *furcifer*, i. 83,* 84.
Chironomys madagascariensis, i. 85,* 86.
Chiroptera, general chars., i. 96.
Chlamydomorphus truncatus, ii. 185, 186.*
Chæropotamus, ii. 138.
Chærotherium, ii. 138.
Cholæpus didactylus, ii. 183.*
 — *Hofmanni*, ii. 183.
Chrysochlorida, gen. chars., i. 125.
Chrysochloris capensis, i. 126.*
Chrysothrix sciurea, i. 69.*
Civet, *African*, i. 189.
 — *Asiatic or Indian*, i. 189.*
Civet-cats, i. 189.
Civets, general characters, i. 188.
Cladobates, i. 114.
 — *Tana*, i. 114, 115.*
Clawed Monkeys, i. 8; general characters, i. 70.
Clidastes, ii. 19.
Climbers, i. 114.
Coati, *Social*, i. 200,* 201.
Coatis, general chars., i. 199; 234.
Cœlogenys paca, ii. 170.*
Colobi, i. 30, 61, 74; general characters, i. 48.
Colobus guereza, i. 47,* 48.
Colonoceras, ii. 59.
Colugo, i. 93,* 94.
Colus tartaricus, ii. 95,* 96.
Condylura, i. 127.
 — *cristata*, i. 125.*
Connochætes, ii. 102.
Cony, ii. 41.
 — *family*, ii. 38, 39.
Corsac, i. 148.*
Cougar, i. 176, 177.*
Couxio, i. 67.*
Coyote, i. 140.*
Coypu, ii. 165.*
Crawlers (Insectivora), i. 120.
Cricetus frumentarius, ii. 154.*
Crocidura aranea, i. 118.*
 — *etrusca*, i. 118.
Crossopus fodiens, i. 118, 119.*
Cryptoprocta, i. 234.
 — *ferox*, i. 184, 185.*
Ctenacodon, ii. 214.
Ctenomys, ii. 166.
Cuscus, ii. 204.
Cuy, ii. 164.*
Cyclothurus didactylus, ii. 188.
Cynailurus, gen. chars., i. 161, 162.
 — *guttatus*, i. 161.*
 — *jubatus*, i. 162.
Cynocephali, i. 73.
Cynocephalus, general chars., i. 53.
 — *Babuïn*, i. 57.*
 — *gelada*, i. 53, 55, 56.*
 — *hamadryas*, i. 55.
 — *leucophaeus*, i. 59.
 — *Mainion*, i. 59.*
 — *Mormon*, i. 53.
 — *niger*, i. 26, 53, 55.*
 — *porcarius*, i. 57.
 — *sphinx*, i. 57.
Cynodon, i. 236, 237.
Cynogale Bennettii, i. 191, 192.*
Cynomorphæ, i. 26, 43.
Cynomys ludovicianus, ii. 148.*
Cynopithecus, i. 53.
 — *niger*, i. 26.
Cynopoda, general chars., i. 192.
Cyon, i. 136.
Cystophora cristata, i. 248.*
 — *proboscidea*, i. 246, 247.*
Dama vulgaris, ii. 84.*
Dasypoda, general chars., ii. 183.
Dasypocta Aguti, ii. 169.*
Dasypus sexcinctus, ii. 185.*
Dasypus family, gen. chars., ii. 200.
Dasypus, i. 237.
 — *ursinus*, ii. 201.*
 — *viverrinus*, ii. 201.*
Dasypoda, general chars., ii. 200.
Dauw, ii. 53.*
Deer, ii. 139, 140.
 — *family*, general chars., ii. 77; 136.
 — *Antlers of*, ii. 74, 223.*
 — *Pampas*, ii. 79, 80.*
 — *Persian*, ii. 82.
 — *Red*, ii. 82.*
 — *Spotted*, ii. 80, 81.*
 — *True*, general characters, ii. 82.
Degu, ii. 166.*
 — *family*, general chars., ii. 166.
Delphinapterus, ii. 10.
Delphinida, general chars., ii. 4.
Delphinus, ii. 5.
 — *delphis*, ii. 5, 6.*
 — *tursio*, ii. 6, 7.*
Delundung, i. 190.*
Dendrohyrax, ii. 41.
Dendrolagus ursinus, ii. 207.*
Dental Characters, i. 16.
 — *Formulæ*, i. 9.
Denticete, ii. 4.
Desmans, general chars., i. 116.
Devexa, general chars., ii. 128.
Diana Monkey, i. 48, 49.*
Diceratherium, ii. 59.
Dichobune, ii. 139.
Dicotyles labiatus, ii. 72.
 — *torquatus*, ii. 72.*
Didactyla or Ruminantia, ii. 73.
Didelphyda, general chars., ii. 195.
Didelphys virginiana, ii. 196, 197.*
Digit, in *Glossary*.
Digitigrada and Plantigrada, i. 6.
Diluvium, ii. 226.
 — *torquatus*, ii. 144.
Dinoceras, ii. 37.
Dinotheria, ii. 35.
Diphyodonts, i. 8.
Dipodida, general chars., ii. 160.
Dipodomys Phillipsii, ii. 162.*
Diprotodon, ii. 212.
Dipus ægyptius, ii. 160,* 161.
 — *mauritanicus*, ii. 160,* 161.
Distribution in Space, i. 12.
Dittherium, i. 236.
Divers (Insectivora), general characters, i. 116.
Dog, *Australian*, i. 143,* 144.
 — *Cape Hunting*, i. 136, 152, 153.*
 — *Domestic*, i. 142.
 — *tribe*, general characters, i. 134.
Dogs, *Proper*, i. 136; general characters, 137.
Dolichotis patagonica, ii. 171.*
Dolphin, *Amazon*, ii. 4, 5.*
 — *Bottle-nosed*, ii. 6, 7.*
 — *Common*, ii. 5, 6.*
 — *Fresh-water*, ii. 4, 5.*
Dolphins, *Marine*, ii. 5.
 — *True*, general characters, ii. 4.
Dormouse family, gen. chars., ii. 148.
 — *Common*, ii. 149, 150.*
Douroucouli, *Three-banded*, i. 70.*
Drill, i. 59.
Dromatherium, ii. 221.
 — *sylvestre*, ii. 213.
Dromedary, ii. 131.*
Dromotherium, i. 127.
Dryolestes, ii. 214.
Dryopithecus, i. 73, 76.
Duck-mole, ii. 217.*
Dugong, ii. 21,* 24.
Duplicidentata, i. 4; ii. 142.
Duyker-bok, ii. 92,* 94.
Earth-hogs, ii. 186.
Earth-wolf, i. 157.*
Echidna aculeata, ii. 219.*
 — *hystrix*, ii. 219.*
 — *setosa*, ii. 219.
 — *Long-spined*, ii. 219.*
 — *Short-spined*, ii. 219.
Echimyda, general chars., ii. 156.
Edentates, general chars., ii. 180.
 — *Wormed-tongued*, general characters, ii. 186.
 — *Geographical Distribution and Descent of the*, ii. 189.
Eland, ii. 100.*
Elasmognathus, ii. 58.
 — *Bairdii*, ii. 44.
Elen, ii. 100.*
Elephant, *African*, ii. 30.*
 — *Indian*, ii. 31.*
Elephants, general chars., ii. 26.
Elephas africanus, ii. 30.*
 — *Cliffii*, ii. 35.
Columbi, ii. 35.
 — *insignis*, ii. 35.
 — *meridionalis*, ii. 35.
 — *primigenius*, ii. 31, 35.
 — *priscus*, ii. 35.
Elephant-shrew, i. 115,* 116.
Elk, ii. 86.*
 — *Canadian*, ii. 86.
 — *Ceylon*, ii. 80.
Emgalo, ii. 69.
Enaliosaurii, ii. 18, 19.
Enhydri marina, i. 231, 232.*
Entellus Monkeys, i. 45.*
Entelodon, ii. 138.
Entomophaga, i. 103.
Eocene, i. 235; ii. 24, 138.
Eohippus Phenacodus, ii. 59.
Eohyus, ii. 138.
Eomeryx, ii. 139.
Epiglottis, ii. 227.
Epithelium, ii. 227.
Equida, general characters, ii. 49.
Equus asinus, ii. 55.
 — *Burchellii*, ii. 53.*
 — *caballus*, ii. 55.
 — *curvidens*, ii. 56, 59.
 — *hemionus*, ii. 54, 55.*
 — *onager*, ii. 54.*
 — *Przevalskii*, ii. 57.
 — *quaggâ*, ii. 53.
 — *tæniopus*, ii. 53,* 54.
 — *Tarpan*, ii. 56,* 57.
 — *Zebra*, ii. 52,* 53.
Erethizon dorsatum, ii. 165.
Eriulus, i. 120.
Erinacei, i. 121.
Erinaceus europæus, i. 122, 123.*
Eriomys chinchilla, ii. 166,* 167.
 — *laniger*, ii. 167.*
Ermine, i. 226.*
Eupleres, i. 126.
Evolution, bearing on dental systems, i. 10.
Eyra, *Brazilian*, i. 180.*

- Fahhad, i. 161,* 162.
 Fallow-cat, i. 171, 172.*
 Fallow-deer, ii. 84.*
 Felida, general chars., i. 158; 234.
 Felines of the New World, i. 175.
 — of the Old World, i. 163.
 — True, general chars., i. 161, 163.
 Felis, i. 163.
 — catus, i. 172, 173.*
 — concolor, i. 176, 177.*
 — eyra, i. 180.*
 — leo, i. 163.*
 — Leopardus, i. 168, 169.*
 — macroscelis, i. 169,* 170.
 — maniculata, i. 171, 172.*
 — marmorata, i. 170, 171.*
 — onca, i. 175.*
 — pajeros, i. 179,* 180.
 — Panthera, i. 168.
 — pardalis, i. 178,* 179.
 — pardinus, i. 183, 184.*
 — Serval, i. 174, 175.*
 — tigris, i. 165.*
 — viverrina, i. 174.*
 Felsinotherium, ii. 24.
 Fennecus, i. 235.
 Fennek, i. 150.*
 Ferret, i. 225.*
 Fiber zibethicus, ii. 159.*
 Field-mouse, ii. 156.
 — Long-tailed, ii. 156.
 Field-vole, Common, ii. 157.*
 Flesh-eaters, general chars., i. 129.
 — Geographical Distribution and Descent of the, i. 234.
 Flipper, ii. 247.*
 Flipper-footed Animals or Seals, i. 239.
 Flying-cat, i. 93,* 94.
 Flying-phalanger, Squirrel, ii. 203, 204.*
 Flying-squirrels, ii. 145.
 Fore- and Hind-limbs, i. 5.
 Fossa, i. 184, 185,* 234.
 Fox, i. 146, 147.*
 — Long-eared, i. 152.*
 — Sahara, i. 150.*
 — White or Arctic, i. 149.*
 Foxes, general characters, i. 144.
 — Flying, i. 101.
 Galago, Common, i. 89.*
 — Grand or Thick-tailed, i. 88.
 — crassicaudatus, i. 88.
 Galagonida, i. 88.
 Galagos, i. 88.
 Galeopithecida, i. 93.
 Galeopithecus, i. 78.
 — volitans, i. 93,* 94.
 Galethylax, ii. 214, 215.
 Galictis, general characters, i. 219.
 — barbara, i. 220.*
 — vittata, i. 220.
 Galidia, i. 234.
 Galidictis, i. 234.
 Garden-shrew, i. 118.*
 Gaur, ii. 124.*
 Gavæus gaurus, ii. 124.*
 — sondaicus, ii. 125, 126.*
 Gayal, ii. 124, 125.*
 Gazella dorcas, ii. 90,* 93.
 Gazelle, ii. 90,* 93.
 Gelada, i. 43, 53, 55, 56.*
 Gelocus, ii. 139.
 Genet, Common, i. 187,* 188.
 Genetta vulgaris, i. 187,* 188.
 Geomys bursaria, ii. 162.*
 Gerbillus, ii. 160.
 Gibbon, White-handed, i. 42, 43.*
 Gibbons, general characters, i. 39.
 Giraffe, general characters, ii. 128.*
 Giraffes, ii. 137, 140.
 Gliraria, ii. 149.
 Globicephalus melas, ii. 8, 9.*
 Glossotherium, ii. 190.
 Glutton, i. 218.*
 Glyptodons, ii. 190.
 Gnawers, general characters, ii. 141.
 Gnu, White-tailed, ii. 103.*
 Gnus, ii. 102.
 Goat, Angora, ii. 107,* 108.
 — Bezoar, ii. 106.*
 — Domestic, ii. 107.
 — Rocky Mountain, ii. 104.*
 Goats, gen. chars., ii. 103; 137.
 Gopher, ii. 167.*
 Gorilla, i. 31, 32, 35,* 74.
 Gravigrada, ii. 190.
 Grind, ii. 8, 9.*
 Grisons, general characters, i. 219.
 Ground Squirrels, ii. 146.
 Guanaco, ii. 134.
 Guazui, ii. 79, 80.*
 Guenons, gen. chars., i. 48, 49.*
 Guereza, i. 47,* 48.
 Guib, ii. 95.*
 Guinea-pig, ii. 171.
 Gulo borealis, i. 218.*
 Gurkur, ii. 54.*
 Gymnorhina, i. 103.
 Gymnura, i. 126.
 — Rafflesii, i. 121.
 Gymnurae, general characters, i. 62.
 Hair, i. 3.
 Halianassa, ii. 24.
 Halicore Dugong, ii. 21,* 24.
 Halmaturus, ii. 207, 208.
 Hamster, Proper, ii. 154.*
 Hand, i. 6.
 Hapale, i. 71.
 — Jacbus, i. 72,* 73.
 — midas, i. 72.
 — rosalia, i. 71,* 72.
 Hapalemur, i. 79.
 — griseus, i. 82,* 83.
 Haploceros americanus, ii. 104.*
 Hare, Alpine, ii. 174, 176.*
 — Common, ii. 174, 175.*
 — Mountain, ii. 174, 176.*
 — Northern, ii. 174, 176.*
 Hares, Piping or Calling, ii. 173.
 Hartebeest, ii. 101.*
 Harvest-mouse, ii. 156.
 Hedgehogs, gen. chars., i. 121, 123.*
 Helaletes, ii. 58.
 Helictis, i. 235.
 Helladotherium, ii. 140.
 Helohyus, ii. 138.
 Herpestes, i. 192.
 — griseus, i. 194.*
 — Ichneumon, i. 193.*
 — Widdringtoni, i. 193.
 Hipparion, ii. 60.
 Hippopotamus, ii. 64,* 136-138.
 — amphibiis, ii. 64.*
 — liberiensis, ii. 64.
 — major, ii. 137.
 — minor, ii. 64, 137.
 Hippotigris, ii. 52.
 — Burchellii, ii. 53.*
 — quagga, ii. 53.
 — Zebra, ii. 52,* 53.
 Hippotragus leucophaea, ii. 99.
 — niger, ii. 98.*
 Hog family, ii. 136, 137.
 Hogs, African, ii. 68.
 — Pigmy, ii. 72.
 Honey-bear, i. 201,* 202.
 Hoolock, i. 41.*
 Horse, Domesticated, ii. 55.
 — family, general chars., ii. 49.
 Horses, ii. 38.
 — African, general chars., ii. 52.
 — Asiatic, general chars., ii. 54.
 — Wild, general characters, ii. 59.
 Howlers, general characters, i. 62.
 Howling Monkey, Red, i. 63.*
 Hunuman, i. 45,* 46.
 Huron, i. 224.
 Hussar Monkey, i. 48.
 Hyæmoschus, ii. 62, 136, 139.
 — aquaticus, ii. 76.
 Hyæna, Brown, i. 157, 237.
 — Spotted, i. 156,* 157, 237.
 — Striped, i. 156,* 237.
 — arvernensis, i. 237.
 — brunnea, i. 157.
 — crocuta, i. 156,* 157, 237.
 — eximia, i. 237.
 — Ferrieri, i. 237.
 — spelea, i. 237.
 — striata, i. 156.*
 Hyænas, gen. chars., i. 154; 234, 237.
 Hyænida, general characters, i. 154.
 Hyænarctos, i. 236.
 Hyænictis, i. 236.
 Hyænodontida, i. 235.
 Hydrochaeruscapybara, ii. 172, 173.*
 Hydromys, ii. 159.
 Hylobates, general characters, i. 39.
 — lar, i. 42, 43.*
 — leuciscus, i. 41.*
 — syndactylus, i. 40.
 Hylomys, i. 114.
 Hyomyschus aquaticus, ii. 76.
 Hyopotamus, ii. 138, 139.
 Hyperoodon, ii. 3.
 — rostratus, ii. 12.*
 Hypsiprymnus penicillatus, ii. 207, 208.*
 Hyrachys, ii. 58.
 Hyracida, ii. 38; general characters, 39; 58.
 Hyracodon, ii. 58.
 Hyracotherium, ii. 213.
 Hyrare, i. 220.*
 Hyrares, general characters, i. 219.
 Hyrax, Abyssinian, ii. 41.*
 — Syrian, ii. 41.
 — capensis, ii. 41.
 — habessinicus, ii. 41.*
 Hystricida, general chars., ii. 163.
 Hystrix cristata, ii. 163.*
 Ibex, general characters, ii. 108.
 — Alpine, ii. 108,* 109.
 — Grecian, ii. 106.*
 Ichneumon, Egyptian, i. 193.*
 — Gray, i. 194.*
 Ichthyopsida, i. 2.
 Ichthyosaurus, ii. 19.
 Icticyon venaticus, i. 219.*
 Ictonyx, i. 235.
 Indris, general characters, i. 77.
 — family, i. 84.
 — or Babakoto, i. 84.*
 Indrisida, general chars., i. 84.
 Inia amazonica, ii. 4, 5.*
 Insect-eaters, gen. chars., i. 112.
 — Geographical Distribution and Descent of the, i. 126.
 Insectivora, general chars., i. 112.
 Inuus, ecaudatus, i. 49, 52.*
 Isard, ii. 89.
 Issyodrimys, ii. 178.
 Jackal, i. 141.*
 — Black-backed, i. 145.*
 — Slender, i. 141.*
 Jackal-gna, i. 152.*
 Jaculus, ii. 160.
 Jaguar, i. 175.*
 Jaguarondi, i. 180.
 Java Monkey, i. 49,* 51.
 Jemmel, ii. 132.
 Jerboa, Egyptian, ii. 160,* 161.
 — family, general chars., ii. 160.
 Jiggetai, ii. 55.
 Jumping-hare, Cape, ii. 161,* 162.
 Jumping-hares, ii. 160.
 Jumping-rabbit of Siberia, ii. 160,* 162.
 Jumping-shrew, Algerian, i. 116.
 Jumping-shrews, i. 115, 127.
 Kahau, i. 46,* 47.
 Kalong, i. 102.*
 Kanchil, ii. 75,* 76.
 Kangaroo, Great, ii. 208.*
 Kangaroos, general chars., ii. 206.
 Kashkar, ii. 111, 112.*
 Kerabau Buffalo, ii. 119.*
 Kiang, ii. 55.
 Kidang, ii. 78.*
 Killer-whale, ii. 3, 8.*
 Kinkajou, i. 201,* 202.
 Kinkajous, i. 234.
 Klippdass, ii. 41.
 Koala, ii. 204, 205,* 215.
 Kobus ellipsiprymnus, ii. 97,* 98.
 Kombu, i. 89.
 Koodoo, ii. 101.*
 Kulan, ii. 55.
 Lagidium, Cuvier's, ii. 167,* 168.
 Lagomys alpinus, ii. 173, 174.*
 Lagostomus trichodactylus, ii. 168.*
 Lagothrix Humboldtii, i. 64.*
 Lagotis Cuvieri, ii. 167,* 168.
 Lama, general characters, ii. 134.
 — peruana, ii. 134,* 135.
 Laopithecus, i. 76.
 Larynx, ii. 229.
 Lemming, ii. 158.*
 Lemur, i. 77.
 — Cat, i. 81,* 83.
 — Dwarf, i. 81,* 83.
 — Fox, i. 81,* 83.
 — Gray or Broad-nosed, i. 82,* 83.
 — Mouse, i. 81, 83,* 84.
 — Ring-tailed, i. 81, 83,* 84.
 — Slow-paced, i. 90.*
 — varius, i. 82.
 Lemuravida, i. 95.
 Lemurida, i. 80.
 Lemurs, i. 80.
 — African Slow, i. 87.
 — Flying, i. 93.
 — Veiled, i. 85.
 — Weasel, i. 81.
 Leopards, Hunting, i. 161, 162.
 Lepidilemur, i. 79, 81.
 Leporida, general chars., ii. 173.
 Leptonyx leopardinus, i. 249.*
 — monachus, i. 249.
 Lepus alpinus, ii. 174, 176.*
 — cuniculus, ii. 175, 177.*
 — europæus, ii. 174, 175.*
 — timidus, ii. 174, 175.*
 — variabilis, ii. 174, 176.*
 Leucoryx, ii. 99.*
 Liehanotus Indris, i. 84.*
 Limbs, i. 4.
 Limnofelis, i. 236.
 Limnotherida, i. 95.
 Linsang, i. 190.*
 Lion, i. 163.*
 Llama, ii. 134,* 135.
 Llamas, general chars., ii. 134; 137.
 Loir, ii. 149.*
 Lophiodon, ii. 58.
 Lophiotherium, ii. 58.
 Loris, i. 77, 89.

- Loris, Plump, i. 89, 90.
 —Slender, i. 90.*
 Lorisida, i. 89.
 Lutra vulgaris, i. 229, 231.*
 Lutreola, i. 227.
 Lutritis, i. 236.
 Lutrada, general characters, i. 229.
 Lycaon, i. 136, 235.
 —pictus, i. 152, 153.*
 Lyncodon patagonicus, i. 229.*
 Lynx, Booted, i. 181.
 —Polar, i. 182, 183.*
 —Spanish, i. 183, 184.*
 —caligatus, i. 181.
 —Caracal, i. 182.*
 —pardinus, i. 183, 184.*
 —vulgaris, i. 182, 183.*
 Lynx-tooth, i. 229.*
 Lynxes, general chars., i. 161, 180.
- Macacus, general characters, i. 49.
 —cynomolgus, i. 49, 51.*
 —ecaudatus, i. 49, 52.*
 —erythraeus, i. 51.
 —Inuus, i. 49, 52.*
 —nemestrinus, i. 74.
 —rhesus, i. 49, 50, 51.*
 —silenus, i. 49, 51.*
 Macaques, gen. chars., i. 49; 74.
 Machairod, i. 236.
 Macropus giganteus, ii. 208.*
 —major, ii. 208.
 Macroscelida, general characters, i. 115; 127.
 Macroscelides Rozeti, i. 116.
 —typicus, i. 115, 116.*
 Macrotherium, ii. 190.
 Madocqua, ii. 92, 94.*
 Magot, i. 49, 52.*
 Maiba, ii. 44.*
 Malbruk, i. 49.
 Mammalia, general chars., i. 2.
 —orders, families, and tribes of, i. 18-22.
 Mammals, i. 2.
 —Non-placental, ii. 192.
 —Pouch-bearing, ii. 192.
 Mammoth, ii. 31.
 Mampalon, i. 191, 192.*
 Manatees, general chars., ii. 22.
 Manatus australis, ii. 22, 23.*
 —senegalensis, ii. 22.
 Mandrill, i. 53, 59.*
 Mangabey, i. 48.
 Mangoustis, gen. chars., i. 192.
 —True, i. 192.
 Manis longicaudata, ii. 189.*
 —pentadactyla, ii. 189.*
 Mara, ii. 171.*
 Marbled Cat, i. 170, 171.*
 Markhor, ii. 105, 106.*
 Marmoset, Silky, i. 71, 72.*
 Marmosets, Common, i. 72, 73.*
 Marmot, Alpine, ii. 147.*
 —Quebec, ii. 147.
 Marmots, True, ii. 147.
 Marsupial, Skeleton of a, ii. 229.*
 Marsupials, general chars., ii. 192.
 —Fruit-eating, gen. chars., ii. 203.
 —Herbivorous, gen. chars., ii. 206.
 —Predaceous, gen. chars., ii. 197.
 —Root-eating, gen. chars., ii. 210.
 —Geographical Distribution and Descent of the, ii. 211.
 Marten, i. 221.
 —American, i. 224.
 —Canadian, i. 224.
 Martens, general chars., i. 218, 220.
 —True, general characters, i. 221.
 Martida, general characters, i. 218.
 Mastodon, ii. 35, 36.
- Mastodon, giganteum, ii. 36.
 Megalonyx, ii. 190.
 Megalotis, i. 235.
 Megamys, ii. 178.
 Megatheriums, ii. 190.
 Mehari, ii. 132.
 Meles, i. 235.
 —taxus, i. 213, 214.*
 Mellivora, i. 217.
 —capensis, i. 216, 217.*
 Mephitis, i. 217, 235.
 —suffocans, i. 217, 218.*
 Meriones, ii. 160.
 Merycopotamus, ii. 137.
 Mesohippus, ii. 60.
 Metaxytherium, ii. 24.
 Mias, i. 36.*
 Microcebus, i. 77, 82.
 —myoxinus, i. 81, 83.*
 Microlestes, i. 127; ii. 213, 221.
 Micromys minutus, ii. 156.
 Midas leoninus, i. 72.
 —ursulus, i. 72.*
 Milk-glands, i. 3.
 Miniopertus Schreiberi, i. 97.
 Mink, i. 228.
 Miohippus, ii. 60.
 Miriki, i. 64, 65.*
 Mirikina, i. 70.*
 Mole, Star-nosed, i. 125.*
 Moles, i. 123, 124.
 —Golden, i. 125, 126.*
 Mole-rat, Common European, ii. 153.*
 Mona, i. 48.
 Monachus albiventer, i. 249.
 Mongoose, i. 194.*
 Monk-seal, i. 249.
 Monkeys, Bushy-eared, general characters, i. 73.
 —Naked-tailed, gen. chars., i. 62.
 —Short-tailed, gen. chars., i. 67.
 —of New World, i. 60.
 —of Old World, i. 32.
 Monodelphia, i. 236.
 Monodon monoceros, ii. 10, 11.*
 Monophyodonts, i. 8.
 Monotremes, gen. chars., ii. 216.
 —Geographical Distribution and Origin of the, ii. 220.
 Moorish Monkey, i. 48.
 Moose-deer, ii. 86.
 Mormon leucophaeus, i. 59.
 —Maimon, i. 59.*
 Morotherium, ii. 190.
 Morse, i. 250.
 Mosasaurs, ii. 19.
 Moschus moschiferus, ii. 76.*
 Mouflon, ii. 111.
 —European, ii. 112, 113.*
 Mouse, Common Domestic, ii. 156.*
 —Opossum or Flying, ii. 204.
 —Striped or Barbary, ii. 156, 157.*
 Mouse family, gen. chars., ii. 153.
 Muntjac, ii. 78.*
 Murida, general characters, ii. 153.
 Mus agrarius, ii. 156.
 —barbarus, ii. 156, 157.*
 —decumanus, ii. 155, 156.*
 —leucogaster, ii. 155.
 —minutus, ii. 156.
 —musculus, ii. 156.*
 —rattus, ii. 155.*
 —striatus, ii. 156, 157.*
 —sylvaticus, ii. 156.
 —tectorum, ii. 155.
 Musangs, i. 190.
 Muscardinus avellanarius, ii. 149, 150.*
 Musimon, ii. 112, 113.*
 Musk-deer, ii. 76, 136.
- Musk-ox, ii. 115, 116, 139.
 Musk-rat, ii. 159.*
 Musk-shrews, i. 116.
 Musquash, ii. 159.*
 Mustela, gen. chars., i. 220, 221.
 —americana, i. 224.
 —erminea, i. 226.*
 —foina, i. 222.*
 —furo, i. 225.*
 —marte, i. 221.*
 —putorius, i. 224, 225.*
 —vulgaris, i. 227.*
 —zobellina, i. 223.*
 Mustelida, gen. chars., i. 211; 234.
 Mycetes, general characters, i. 62.
 —seniculus, i. 63.*
 Mydaus, i. 235.
 —Telagon, i. 215, 216.*
 Myiopithecus, i. 48.
 Myodes lemmus, ii. 158.*
 Myogale, i. 116.
 —moschata, i. 116.*
 —pyrenaica, i. 116.
 Myogalida, i. 116.
 Myopotamus coypu, ii. 165.*
 Myops, ii. 178.
 Myoxida, general chars., ii. 148.
 Myoxus, ii. 178.
 —avellanarius, ii. 149, 150.*
 —glis, ii. 149.*
 Myrmecobius, ii. 213.
 —fasciatus, ii. 199.*
 Myrmecophaga jubata, ii. 187.*
 Myrmidon didactylus, ii. 188.*
 Mysticete, general chars., ii. 14.
- Nails, i. 3.
 Narwhal, ii. 10, 11.*
 Nasicornia, general chars., ii. 44.
 Nasua socialis, i. 200, 201.*
 Necrolemur, i. 94; ii. 139.
 Nisnas Monkey, i. 48.
 Noctule, i. 106.*
 Notherium, ii. 212.
 Nyctereutes, i. 235.
 —viverrinus, i. 151.*
 Nycticebus tardigradus, i. 89.
 Nyctipithecus, i. 69.
 —trivirgatus, i. 70.*
 Nylgau, ii. 96, 97.
- Obesa, general characters, ii. 64.
 Ocelot, i. 178, 179.*
 Octodon Cumingii, ii. 166.*
 Octodontida, gen. chars., ii. 166.
 Onager, ii. 54.*
 Ondatra, ii. 159.*
 Opomeryx, ii. 139.
 Opossum, Common, ii. 196, 197.*
 Opossums, gen. chars., ii. 195; 215.
 Oral, ii. 144, 145.*
 Orang-utang, i. 36.*
 Orca gladiator, ii. 3, 8.*
 Oreodon, ii. 139.
 Oreotragus saltator, ii. 91, 93.*
 Original, ii. 86.
 Ornithorhynchus paradoxus, ii. 217.*
 Orohippus, ii. 60.
 Orycteropus, ii. 180.
 —capensis, ii. 186, 187.*
 Oryx, ii. 99.
 —leucoryx, ii. 99.*
 Otaria jubata, i. 243.
 —Stelleri, i. 243.*
 —ursina, i. 244, 245.*
 Otarida, general chars., i. 241.
 Otocyon, i. 136.
 —caffer, i. 152.*
 —megalotis, i. 152.*
 Otolicnus agisymbanus, i. 89.
- Otolicnus crassicaudatus, i. 88.
 —galago, i. 89.*
 Otter, European, i. 229, 231.*
 —Sea-, i. 231, 232.*
 Otters, general characters, i. 229.
 Ouakari, i. 67.*
 Ouistiti, i. 72, 73.*
 Ovibos moschatus, ii. 115, 116.*
 Ovis Argali, ii. 112.
 —aries, ii. 114.
 —montana, ii. 111.*
 —musimon, ii. 112, 113.*
 —nivalis, ii. 111.
 —Polii, ii. 111, 112.*
 —tragelaphus, ii. 110.*
 Ox, Burmese Wild, ii. 125, 126.*
 —Humped, ii. 126, 127.*
 —group, general chars., ii. 115.
 Oxen, ii. 137, 139.
 —True, general chars., ii. 123.
- Paca, ii. 170.*
 Pachyderms, ii. 38.
 Pad-footed family, ii. 129.
 Pajou, ii. 185.*
 Palaeocastor, ii. 178.
 Palaeotherida, ii. 213.
 Palaeotherium, ii. 60.
 Pale-buck, ii. 91, 93.*
 Panda, i. 203, 234.*
 Pangolin, Long-tailed, ii. 189.*
 —Short-tailed, ii. 189.*
 Pangolins, general chars., ii. 188.
 Panther, African, i. 168.
 —Asiatic, i. 168.
 Paradoxure, Common, i. 191.*
 Paradoxures, i. 190.
 Paradoxurus typus, i. 191.*
 Paramys, ii. 178.
 Paseng, ii. 106.*
 Peccaries, ii. 136.
 —American, general chars., ii. 72.
 Peccary, Collared, ii. 72.*
 —White-lipped, ii. 72.
 Pedetes caffer, ii. 161, 162.*
 Pedimana, ii. 195.
 Pekan, i. 224.
 Pelvic Bones, ii. 230.*
 Peralestes, ii. 214.
 Perameles nasuta, ii. 198.*
 —Pig-footed, ii. 198, 199.*
 Peramelida, general chars., ii. 197.
 Peratherium, ii. 212, 214, 215.
 Percherus, ii. 138.
 Perissodactyla, ii. 58.
 —general characters, ii. 38.
 Petaurus sciureus, ii. 203, 204.*
 Petrodromus, i. 116, 127.
 Petrogale xanthopus, ii. 208, 209.*
 Phacochoerus, ii. 138.
 —aethiopicus, ii. 69.*
 —africanus, ii. 69.
 Phalanger, Vulpine, ii. 204, 205.*
 —family, general chars., ii. 203.
 Phalangista vulpina, ii. 204, 205.*
 Phalangistida, gen. chars., ii. 203.
 Pharaoh's Rat, i. 193.*
 Phascogale, Brush-tailed, ii. 200.*
 —penicillata, ii. 200.*
 Phascolarctos cinereus, ii. 204, 205.*
 Phascolomys latifrons, ii. 210.*
 Phascolotherium, ii. 213.
 Phillips's Pocket-mouse, ii. 162.*
 Phoca groenlandica, i. 249, 250.*
 —vitulina, i. 249.
 Phocena communis, ii. 7.*
 Phocida, general chars., i. 246.
 Phyllostoma spectrum, i. 108, 109.*
 Phyllostomata, i. 107.
 Physalus antiquorum, ii. 15, 16.*
 Physeter macrocephalus, ii. 13.*

- Physcterida, general chars., ii. 12.
 Pichichiago, ii. 185, 186.*
 Pig family, general chars., ii. 66.
 Pigs, Ruminant, ii. 138.
 — True, ii. 67, 136, 137.
 Pika, Alpine, ii. 173, 174.*
 Pine-marten, i. 221.*
 Pinnipedia, general chars., i. 239.
 Pipistrelle, i. 106, 107.*
 Pithecia Satanas, i. 67.*
 Pithesciurus sciureus, i. 69.*
 Plagiaulax, ii. 179, 213.
 Plantigrade Hind-limb, ii. 231.*
 Platanista gangetica, ii. 4, 5.*
 Plate Beaver, ii. 165.
 Platygonus, ii. 138.
 Platypus, Duck-billed, ii. 217.*
 Platyrrhinæ, i. 60.
 Platyrrhines, American, i. 73.
 Plecotus auritus, i. 97, 104.*
 Pleistocene, ii. 35.
 Plesiartomys, ii. 178.
 Plesiosaurus, ii. 19.
 Pliocene, i. 135; ii. 137.
 Pliohippus, ii. 60.
 Pliolophus vulpiceps, ii. 213.
 Pocket-mice, ii. 162.
 Poephaga, general chars., ii. 206.
 Poëphagus grunniens, ii. 123.*
 Polar Bear, i. 205.*
 Polecat, i. 224, 225.
 — Tiger, i. 226.
 Polecats, i. 220, 224.
 Polydactyla, ii. 61, 64.
 Porcula, ii. 72.
 Porcupine, African Brush-tailed, ii. 163, 164.
 — Common European, ii. 163.*
 — family, general chars., ii. 163.
 Porcus, ii. 138.
 — habirussa, ii. 71.*
 Porpoise, ii. 7.*
 Portax pictus, ii. 96, 97.
 Potamochoerus penicillatus, ii. 69.*
 — porcus, ii. 69.*
 Potamogale, i. 126.
 Potoroos, ii. 207.
 Potto, i. 87.*
 — family, i. 87.
 Poyou, ii. 185.*
 Prairie-dog, ii. 148.*
 Priodonta gigas, ii. 184, 185.*
 Prionodon gigas, ii. 184, 185.
 — gracilis, i. 190.*
 Proboscidea, gen. chars., ii. 26.
 Proboscideans, Geographical Distribution and Descent of, ii. 35.
 Proboscis-bears, general chars., i. 199.
 Proboscis Monkey, i. 46, 47.
 Probubalus depressicornis, ii. 114, 115.
 Procyon cancrivorus, i. 198.
 — Hernandezi, i. 198.
 — lotor, i. 198, 199.*
 Propithecus, i. 79, 85.
 Prorastomus, ii. 24.
 Prosimians, general chars., i. 77.
 — African, i. 87.
 — East Indian, i. 89.
 — of Madagascar, i. 80.
 — Geographical Distribution and Descent of the, i. 94.
 Prosimii, general chars., i. 77.
 Proteles, i. 234.
 — Lalandii, i. 157.*
 Protomodon, ii. 212.
 Protohippus, ii. 60.
 Pseudaelurus, i. 236.
 Pterodicticus Potto, i. 87.*
 Pterodictida, i. 87.
 Pterodon, i. 237.
 Pteromys petaurista, ii. 144, 145.
 — volucella, ii. 145.
 Pteropida, i. 101.
 Pteropus edulis, i. 102.*
 Ptilocercus, i. 114.
 Puma, i. 176, 177.*
 Putorius, i. 220, 224.
 — erminea, i. 226.*
 — foetidus, i. 224, 225.
 — furo, i. 225.*
 — lutreola, i. 228.*
 — sarmaticus, i. 226.
 — sibiricus, i. 228.
 — vulgaris, i. 227.
 — vison, i. 228.
 Pygarg, ii. 100.
 Quagga, ii. 53.
 Quaternary Period, ii. 137.
 Rabbit, ii. 175, 177.*
 — family, general chars., ii. 173.
 Raccoon, Common, i. 198, 199.*
 — Crab-eating, i. 198.
 — Mexican or Black-footed, i. 198.
 Raccoons, general characters, i. 198; 234.
 Rangifer tarandus, ii. 84, 85.*
 Rapaces, ii. 197.
 Rat, Black, ii. 155.*
 — Brown, ii. 155, 156.
 Rats and Mice, ii. 155.
 Rat-kangaroo, Tufted-tailed, ii. 207, 208.*
 Ratelus, i. 217.
 — capensis, i. 216, 217.
 Reduncus eleotragus, ii. 94.*
 Reed-buck, ii. 94.*
 Reindeer, ii. 84, 85.*
 Reproduction, i. 11.
 Retia mirabilia, ii. 181.
 Rhesus Monkeys, i. 50.*
 Rhinoceros, ii. 38.
 — family, general chars., ii. 44.
 — African, ii. 47.
 — Two-horned, ii. 47.*
 — bicornis, ii. 47.*
 — indicus, ii. 47.*
 — javanicus, ii. 47.
 — simus, ii. 46, 47.
 — sumatrensis, ii. 47.
 — tichorhinus, ii. 45, 59.
 Rhinoceroses, ii. 59.
 Rhinolophus, i. 98, 109.
 — ferrum-equinum, i. 110.*
 — hipposideros, i. 110.
 Rhinopoma microphyllum, i. 107, 108.*
 Rhizophaga, general chars., ii. 210.
 Rhytina, ii. 21, 24.
 Rhyzæna tetradactyla, i. 195.*
 Rietbok, ii. 94.*
 River-hog, Red, ii. 69.*
 River-hogs, ii. 68, 136.
 River-horses, general chars., ii. 64.
 Rock-badger family, general characters, ii. 39; 58.
 Rock-kangaroo, Yellow-footed, ii. 208, 209.*
 Rock-systems of the earth, i. 23.
 Rodents, general characters, ii. 141.
 — Geographical Distribution and Descent of the, ii. 175.
 Roe, Common, ii. 79.*
 Rorqual, ii. 15, 16.
 Ruminants, Hollow-horned, general characters, ii. 87; 137.
 — Stomach of, ii. 232.*
 Runners (Insectivora), i. 117.
 Rupicapra tragus, ii. 89.*
 Sable, i. 223.*
 Sai, i. 66.*
 Saiga, ii. 95, 96.
 — tartarica, ii. 95, 96.
 Saimiri, i. 69.*
 Sajous, i. 61; general chars., i. 65.
 Saki, Black, i. 67.*
 Sakis, general characters, i. 66.
 — proper, i. 67.
 Saphan, ii. 41.
 Sasnassu, i. 68.*
 Sassa, ii. 91, 93.
 Sassi, ii. 102.*
 Sauropsida, i. 2.
 Scalops, i. 127.
 — canadensis, i. 125.
 Scelidotherium, ii. 191.
 Scherrius, ii. 158.
 Scirtetes, ii. 162.
 Sciuravus, ii. 178.
 Sciurida, general characters, ii. 144.
 Sciurus, ii. 178.
 — vulgaris, ii. 145, 146.
 Sea-bear, i. 244, 245.*
 Sea-calf, i. 249.
 Sea-cows, general characters, ii. 20.
 — Geographical Distribution and Descent of the, ii. 24.
 Sea-elephant, i. 246, 247.*
 Sea-leopard, i. 249.*
 Sea-lion, Steller's, i. 243.*
 Sea-reptiles, ii. 18.
 Seal, Bladder-nosed, i. 248.*
 — Common, i. 249.
 — Greenland, i. 249, 250.*
 Seals, general characters, i. 239.
 — Eared, i. 241.
 — True, general characters, i. 246.
 — Geographical Distribution and Descent of the, i. 253.
 Selenodontia, ii. 62.
 Semnopithecus, gen. chars., i. 46; 73.
 Semnopithecus entellus, i. 45, 46.
 — nasica, i. 46, 47.
 Serval, i. 174, 175.*
 Sheep, general chars., ii. 109; 137.
 — Barbary Wild, ii. 110.*
 — Domesticated, ii. 114.
 — Rocky Mountain, ii. 111.*
 Shoulder-girdle, i. 5.
 Shrew of Tuscany, i. 118.
 Shrews (Insectivora), i. 117.
 Siamang, i. 40.
 Simia, general characters, i. 36.
 — satyrus, i. 36.*
 Simia, general characters, i. 25.
 — American, i. 74.
 Sing-Sing, ii. 97, 98.
 Sirenia, general characters, ii. 20.
 Sivatherium, ii. 140.
 Skeleton, i. 4.
 Skin, i. 3.
 Skull, i. 4, and *Glossary*.
 Skunk, Brazilian, i. 217, 218.
 Skunks, i. 217.
 Sloth, Three-toed, ii. 182.*
 — Two-toed, ii. 183.*
 Sloths, general characters, ii. 181.
 Solenodon paradoxum, i. 120.*
 Sorex etruscus, i. 118.
 Soricida, i. 117.
 Soulik, ii. 147.*
 Spalacotherium, i. 127; ii. 213, 214.
 Spalax typhlus, ii. 153.*
 Spectre-tarsier, i. 91, 92.
 Spermophiles, gen. chars., ii. 146.
 — citillus, ii. 147.*
 Sperm-whale, ii. 13.*
 — family, general characters, ii. 12.
 Spider-monkeys, i. 30, 61, 64.
 Spietboks, ii. 99.
 Spiny Rat family, general characters, ii. 165.
 Squirrel, Brown Flying, ii. 144, 145.
 — Common, ii. 145, 146.
 — Chipping, ii. 146.*
 — family, general chars., ii. 144.
 Squirrels, True, ii. 145.
 Squirrel-monkey, i. 69.*
 Stag, Canadian, ii. 82.
 — Common, ii. 82.*
 Steinbocks, general chars., ii. 108.
 Stenoeffer, ii. 178.
 Stenodon, ii. 35.
 Stenops gracilis, i. 50.*
 — tardigradus, i. 89.
 Stereognathus, ii. 213, 214.
 Stheniurus, ii. 212.
 Stoat, Common, i. 226.*
 Stomach of Ruminant, ii. 232.*
 Stone-marten, i. 222.*
 Strepsiceros kudu, ii. 101.*
 Stylodon, ii. 214.
 Subdivision of Mammals based on presumed order of Evolution, i. 14.
 Subulo rufus, ii. 79.*
 Subungulata, general chars., ii. 169.
 Subursida, general chars., i. 198.
 Suida, general characters, ii. 66.
 Superficial Glands, i. 3.
 Suricata tetradactyla, i. 195.*
 Sus, ii. 138.
 — palustris, ii. 68.
 — scrofa, ii. 67.*
 Swarte-bok, ii. 98.*
 Synotus barbastellus, i. 104, 105.
 Tafa, ii. 200.*
 Taguan, ii. 144, 145.
 Tailed Monkeys, gen. chars., i. 42.
 Talapoin, i. 48.
 Talpa europæa, i. 123, 124.*
 Talpida, i. 123.
 Tamandua tetradactyla, ii. 188.
 Tamias striatus, ii. 146.*
 Tana, i. 114, 115.*
 Tanreos, i. 120, 121.*
 Tapir, Andes or Hairy, ii. 44.
 — Baird's, ii. 44.
 — Brazilian, ii. 42, 43.
 — Malayan, ii. 44.*
 — Shabrack, ii. 44.*
 — family, general chars., ii. 41.
 Tapirs, ii. 38, 58.
 Tapirulus, ii. 58.
 Tapirus americanus, ii. 42, 43.
 — Bairdii, ii. 44.
 — indicus, ii. 44.*
 — malayanus, ii. 44.*
 — Roulinii, ii. 44.
 — villosus, ii. 44.
 Tarandus rangifer, ii. 84, 85.*
 Tarpan, ii. 56, 57.
 Tarsius, i. 77.
 — spectrum, i. 91, 92.
 Tasmanian Devil, i. 237; ii. 201.*
 — Wolf, ii. 202, 214.
 Taxidea, i. 235.
 Tayra, i. 220.*
 Tee-tees, i. 68.
 Teeth, i. 6, and *Glossary*.
 — Milk and Permanent, i. 8.
 — Structure of the, i. 7.
 Telagou, i. 215, 216.
 Tendracs, i. 120.
 Tetracerus quadricornis, ii. 93, 94.
 Theridomys, ii. 178.
 Theropithecus, i. 53.
 Thlinohyus, ii. 138.
 Thylacinus cynocephalus, ii. 202.*
 Thylacoleo, ii. 211, 214.
 Thylacotherium, ii. 213.

- Tiger, i. 165.*
 — Clouded, i. 169.* 170.
 Tiger-horses, ii. 52, 59.
 Tinodon, ii. 214.
 Titanomys, ii. 179.
 Tragelaphus scriptus, ii. 95.*
 Tragulida, general characters, ii. 76; 136, 139.
 Tragulus pygmaeus, ii. 75.* 76.
 Tree-kangaroo, Ursine, ii. 207.*
 Tree-porcupine, Tri-coloured, ii. 164.*
 Triacanthodon, ii. 214.
 Trichecus rosmaurus, i. 250.*
 Triconodon, i. 127; ii. 214.
 Troglodytes, i. 31, 32, 74.
 — gorilla, i. 35.*
 — niger, i. 33.
 — Tchego, i. 35.
 Tupaia, i. 114.
 Tupaias, Climbing, i. 126.
 Tur, ii. 127.
 Tylopoda, ii. 129.
 Umseke, ii. 94.*
 Unau, ii. 180, 183.*
 Ungulates, Even-toed, ii. 36.
 — — general characters, ii. 61.
 — — Geographical Distribution and Descent of the, ii. 136.
 — Odd-toed, gen. chars., ii. 38.
 Ungulates, Odd-toed, Geographical Distribution and Descent of the, ii. 58.
 Ur, Urus, ii. 120, 126.
 Urebi, ii. 91.* 93.
 Ursida, general chars., i. 196, 204.
 Ursons, ii. 165.
 Ursus americanus, i. 208,* 209.
 — arctos, i. 207.*
 — ferox, i. 206.
 — horribilis, i. 206.
 — labiatus, i. 210.*
 — malayanus, i. 209,* 210.
 — maritimus, i. 205.*
 Vampire, True, i. 108, 109.*
 Vermilingua, gen. chars., ii. 186.
 Vertebra, ii. 233.*
 Vertebrata, general characters and different types of, i. 1.
 Vespertilio Daubentoni, i. 105.*
 — murinus, i. 105.
 Vespertilionidae, i. 103.
 Vesperugo Nilsoni, i. 107.
 — noctula, i. 97, 106.
 — pipistrellus, i. 106, 107.*
 Vicuña, ii. 134, 136.
 Vison, American, i. 228.
 — European, i. 228.*
 — Siberian, i. 228.
 Visions, general chars., i. 225, 227.
 Viverra Civetta, i. 189.
 — Dog, i. 151.*
 — Zibetha, i. 189.*
 Viverrida, gen. chars., i. 186; 234.
 Viverrine Cat, i. 174.*
 — Dasyure, ii. 201.*
 Viverrines, general chars., i. 186.
 Vizcacha, ii. 168.*
 Voles, general characters, ii. 157.
 Vulpes, i. 144.
 Wallaby, ii. 206.
 Walrus, i. 250.
 Waluvi, i. 83,* 84.
 Wanderoo, i. 49, 51.*
 Wapiti, ii. 82.
 Wart-hogs, general chars., ii. 69.
 Waterbok, ii. 97,* 98.
 Water-hogs, ii. 136.
 Water-mole, ii. 217.*
 Water-rat, ii. 158.*
 Water-shrew, i. 118, 119.*
 Water-vole, ii. 158.*
 Weasel, Proper, i. 227.*
 Weasels, general chars., i. 225.
 Weeper Capuchin, i. 66.*
 Whale, Bottlehead or Common Beaked, ii. 12.*
 — Caaing, ii. 8.*
 — Cape, ii. 16.
 — Greenland, ii. 16.*
 Whale, Pilot, ii. 8.*
 — Right, ii. 16.
 — White, ii. 10.*
 Whales, Bottle-nosed, ii. 3.
 — Fin-backed, ii. 16.
 — Toothed, general chars., ii. 4.
 Whales and Dolphins, general characters, ii. 1.
 — — Geographical Distribution and Descent of the, ii. 17.
 Whalebone Whales, general characters, ii. 14.
 Wildebeest, ii. 103.*
 Wolf, African, i. 138,* 139.
 — Common, i. 137.*
 — Maned, i. 139.*
 — Prairie, i. 140.*
 Wolves, general characters, i. 137.
 Wombat, Broad-fronted, ii. 210.*
 Woolly Monkeys, i. 64.
 Wuychuchol, i. 116.*
 Xiphodon, ii. 139.
 Yak, ii. 123.*
 Yapock, ii. 194, 196.*
 Yurumi, ii. 187.
 Zebra, ii. 52,* 53.
 Zebu, ii. 126, 127.*
 Zeuglodons, ii. 19.

98

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